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The Journal of the American Welding Society

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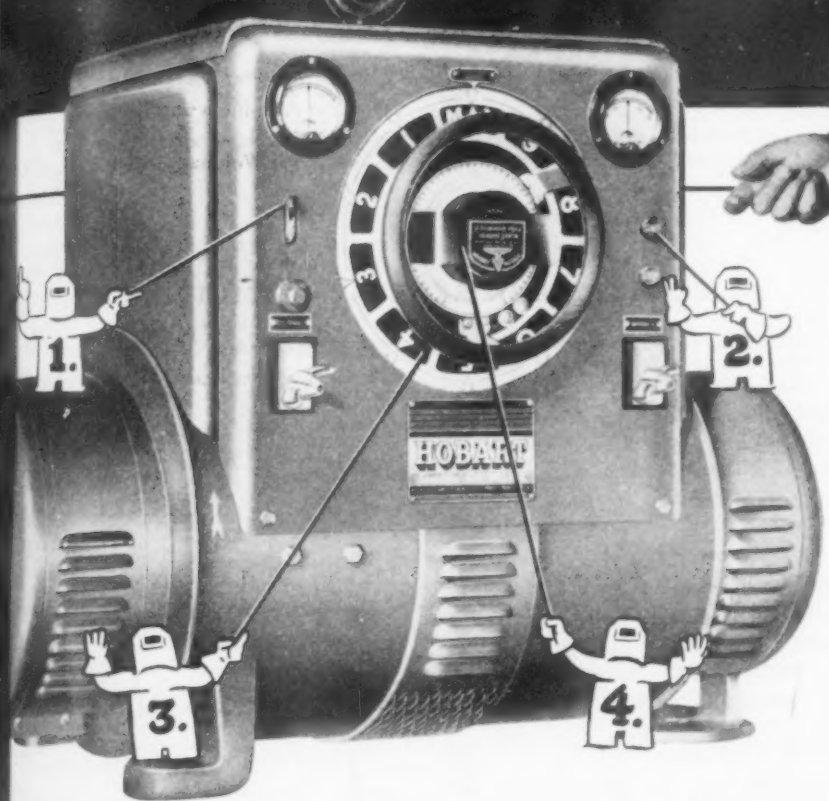

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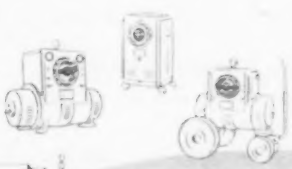

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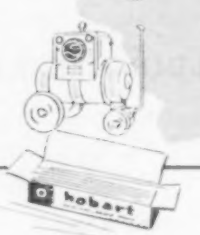

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The Journal of the American Welding Society

Published for the Advancement of the Science and Art of Welding

W. SPRARAGEN, Editor

SEPTEMBER, 1944

VOLUME 23 NUMBER 9

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COVER

Assembling Bilge Section of Tanker. *Courtesy Bethlehem Steel Company.*

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The Structural Reinforcement of Liberty Ships

SINCE the inception of the "Board to Investigate the Design and Methods of Construction of Welded Steel Merchant Vessels" numerous specific steps have been taken to control the difficulties which have occurred. There has been a great deal of conjecture in shipbuilding and shipping circles regarding the measures which have been taken and their intended purpose. It has been impossible in the past to disclose the problems in their true light, but now that the difficulties are more fully understood and the scope and gravity of the situation can be evaluated, it is possible to set down the problems that presented themselves and the steps which were taken through the combined efforts of the U. S. Navy, U. S. Coast Guard, U. S. Maritime Commission and the American Bureau of Shipping.

The first step taken was to educate the shipyard personnel, inspectors and surveyors in the more obvious causes which were contributing to the structural failures. Three pamphlets, whose contents were quite similar, were issued. The Coast Guard and American Bureau of Shipping issued instructions to their inspectors and surveyors, and the Maritime Commission printed a handy pamphlet which was circulated to all shipyard personnel in supervisory capacities and to all inspectors and surveyors. At the same time orders were issued to the shipyards to make specific alterations in two or three items on new vessels which were known to have contributed to the failures. These included the elimination of a cut in the sheer strake of the Liberty ships in way of the gangway, freeing of the bulwark from the top of the sheer strake on the Liberty ships, serrating the bilge keel on both the Liberty ships and T-2 tankers, and adding large girders beneath the deck of the T-2 tankers.

By the end of the summer of 1943, the more obvious difficulties had been largely removed from new ships, but it was apparent that there was a tendency in the repair yards to conclude that, since a plate had cracked, it must of necessity have been rolled of defective material. The ship repair yards were removing large quantities of plating in effecting the repairs. Study showed, however, that the material complied with existing specifications and that new material introduced in the repair was, in all probability, in no way superior to that removed. Instructions were therefore issued in Marine Inspection Memorandum No. 64 covering the repairs of structural failures.

It also became evident that the majority of reports of structural failures were not complete enough to permit study of the more elusive causes. New forms were therefore devised for making the reports so that important information would not be omitted. Large diagrams were drawn for the Liberty ships and T-2 tankers on which the location of the fracture or buckling could be indicated and on which spaces were provided for all of the pertinent data so that inadvertent omission of important facts would be avoided. A third form of letter-size, NAV-CG 2752, was devised for reporting structural failures on vessels other than the Liberty ships and tankers. In order to establish definite procedures for making these reports, Marine Inspection Memorandum No. 57 was issued. All of these data were distributed, not only to the Merchant Marine Inspectors of the Coast Guard, but to the Maritime Commission, Navy Department, American Bureau of Shipping, the British Corporation and the British Admiralty, and at the present time structural failure reports are being received through the regular channels of all these agencies.

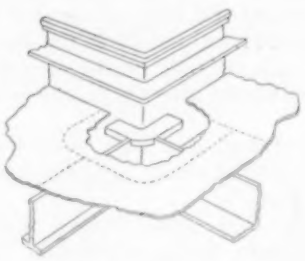


Fig. 1—Outside View of Hatch Corner in Upper Deck of Earlier Liberty Ship Shows Original Design Including 51-Lb. Doubler Beneath Deck and Welding Around Insert Plate

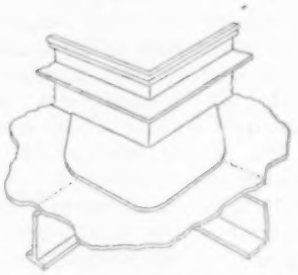


Fig. 2—Outside View of Hatch Corner in Upper Deck of New Liberty Ship. The 20-Lb. Doubler Is Shown on Top of Deck and Covering Insert Plate

The structural reinforcements to be added are intended to serve two purposes: First, steps are taken to eliminate as many crack starters as possible; and second, barriers are introduced to limit the progress of any crack which might start from an undetected origin.

It has been found that practically any square corner introduced into the material may prove a source of difficulty. Square corners are therefore to be rounded in so far as practicable, and, in the case of the hatch corners which are a proved source of difficulty, specific reinforcements are to be added. Figure 1 shows the original reinforcement provided on most of the existing Liberty ships.

On new vessels an improved corner reinforcement is being fitted during the construction period. The reinforcement for new vessels is shown in Figs. 2 and 3. Orders for this change were issued in August 1943. On vessels which were not reinforced at the hatch corner, as shown in Figs. 2 and 3, a rounded insert corner with face plate is being fitted as shown in Fig. 4.

On the earlier Liberty ships a bulb bar bilge keel was used. In welding the butts care was seldom taken to

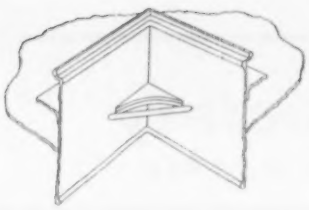


Fig. 3—Inside View of Hatch Corner in Upper Deck of New Liberty Ship. The 20-Lb. Doubler Plate and Insert Plate Are Shown Slotted Through the Hatch Coaming and Rounded to a 1-Ft. Radius

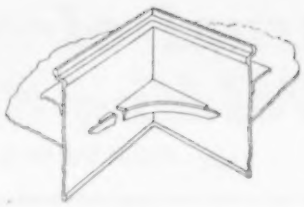


Fig. 4—Inside View of Hatch Corner in Upper Deck of Liberty Ship. The Corner Reinforcement to Be Provided on Existing Vessels Is Shown in Place

see that the entire section was penetrated by the welding and a cavity was generally left in the heart of the bulb. The bilge keel is the outermost bottom fiber of the ship's hull girder and as the vessel bends and twists in the seaway it is severely strained. About half of the underwater shell fractures have been traced directly to a defective butt weld in a bilge keel.

On vessels whose bilge keel had not been serrated during construction, holes are to be made opposite the butt welds, as shown in Figs. 5 and 6.

Since there is a possibility that some cracks may emanate from undetected starters, such as cracked or imperfect welds, a barrier is to be provided to arrest such cracks before extensive damage results. From years of experience on riveted vessels, it is known that a riveted seam forms a barrier to a crack and, although an extensive study is still underway, no barrier has yet been found which is more satisfactory than a riveted seam. In reinforcing the Liberty ships, a riveted seam was, therefore, provided at the gunwale by cutting either the stringer plate or the sheer strake and fitting a riveted gunwale angle or strap, as shown in Figs. 7 and 8. In order to limit further the propagation of fractures and in order to stop them near the hatches, which are the principal offenders, another riveted seam is to run beside the hatches, as shown in Figs. 9 and 10.

In January 1944 it was found that some of the Liberty ships which had been operated in extremely heavy weather had developed buckles in the bottom of the after end of No. 3 hold. These buckles occurred in both the bottom and inner bottom of the vessel. Not many vessels developed this buckling and since it appeared that it was not serious enough to occasion great concern, no steps were taken except in the case of the troopships where difficulties in ballasting aggravated the situation and where so many lives were at stake that it became advisable to lean over backward in providing extra precautions. In these vessels four additional longitudinal girders are to be fitted.

The Board appointed by the Secretary of the Navy to study the problem is still vigorously pursuing the causes of the fractures and will continue until a complete solution to all of the problems involved is reached. While the program of reinforcement is going on, various govern-

Fig. 5—Bilge Keel Showing Serrations Such as Would Be Provided on a New Vessel

Fig. 6—Bilge Keels on Existing Vessels Showing Holes Provided at Each Bilge Keel Butt on Dry Cargo and Tank Vessels (Left) and Troop Ship Conversions (Right)

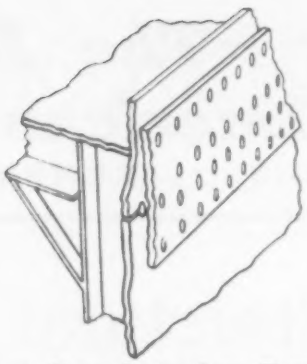


Fig. 7—Sheer Strake Strap Showing Torch Cut in Sheer Strake Just Beneath Upper Deck

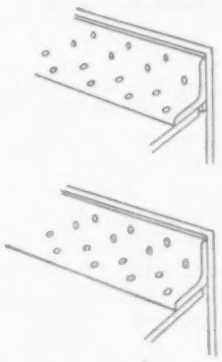


Fig. 8—Riveted Gunwale Angle Showing Arrangement for Existing Vessels with Torch Cut Through Stringer Plate (Above) and for New Vessels (Below)

ment, commercial and university laboratories are engaged in tracking down the more remote causes for the difficulties.

The details of the design, the characteristics of the materials, the methods of construction and restrictions on ballasting during operation are being studied. There is every reason to believe that these studies will locate the causes and cures of practically all of the difficulties which have beset our vessels and that after the war we shall be in a position to continue to build welded merchant vessels with the expectation of 100% security.

TIME LIMITS FOR FITTING REINFORCEMENTS

In February 1944 a policy was agreed upon by representatives of the Navy Department, War Department, Coast Guard, Maritime Commission, War Shipping Administration and American Bureau of Shipping, relative to the urgency of reinforcements on the

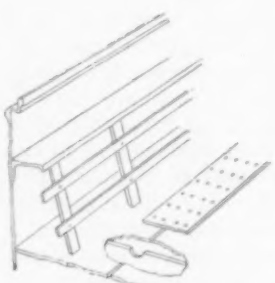


Fig. 9—Deck Strap Beside Hatch on Dry Cargo or Tank Vessel

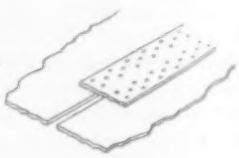


Fig. 10—Deck Strap on Troop Ship Conversion

various types of vessels. In establishing this policy, the vessels were divided into three classes: (1) Vessels Under Construction; (2) Existing Dry Cargo and Tank Vessels; and (3) Troopship Conversions. The details of this policy follow:

Vessels Under Construction (Policy established March 13, 1944)

Vessels under construction where the stringer plate has not been welded to the sheer strake plate shall be considered new vessels and shall have the gunwale angle fitted during construction. Vessels under construction where the stringer plate has already been welded to the sheer strake shall be considered existing vessels (in so far as the fitting of the deck straps and gunwale connections are concerned). On existing vessels where the date of

delivery is still two or three weeks remote, structural reinforcements should be fitted even if a delay of three or four days in delivery results. A short delay in the beginning is better in the long run, because the vessel will not have to be removed from service in order to fit the reinforcements at a later date. For existing vessels, where the date of delivery is only two or three days off, the urgency of the vessel's expected mission, its anticipated route, etc., should be considered in accordance with the specifications of February 8, 1944 (below).

Existing Dry Cargo Ships and Liberty Ships Converted to Tankers

(*a*) Vessels which have sustained hull damage serious enough to require extensive repairs shall have these alterations made in addition to the repairs.

(*b*) Vessels which are scheduled to make voyages where low atmospheric temperatures and heavy seas may be expected, such as in the North Atlantic or Gulf of Alaska in wintertime, shall have the hatch corners reinforced as per item (*A*) (in specifications which follow) prior to making such voyages, except where extreme military emergency will not permit.

(*c*) All vessels must have all of the alterations completed as soon as possible.

Existing Liberty Type Troopship Conversions

(*a*) Vessels which are undergoing extensive repairs shall have these alterations made in addition to the repairs.

(*b*) Vessels which are scheduled to make voyages where low atmospheric temperatures and heavy seas may be expected such as in the North Atlantic or Gulf of Alaska in wintertime shall have the hatch corners reinforced as per item (*A*) (in specifications which follow), the deck altered as in item (*B*), and shall have an alteration made at the gunwale in accordance with item (*C*), prior to making such voyages. No exceptions will be made to this requirement, unless serious delay would result because of a lack of repair facilities or a condition of extreme military emergency prevails.

(*c*) All vessels must have all of the alterations specified herein completed at the earliest possible date.

DETAIL SPECIFICATIONS

Vessels Now Under Construction

All Liberty-type vessels under construction in the shipyards on which stringer plates have not yet been welded to the sheer strake shall be subject to the following:

1. Maritime Commission Plan EC2-S-C1-S-11-6-6, "Structural Reinforcements." This plan was forwarded to the Officers in Charge, Marine Inspection, having jurisdiction over shipyards constructing Liberty ships on February 26, 1944.

2. Maritime Commission Plan S11-6-4A, Alt. A, "General Arrangement of Gunwale Angle—Deck Scupper and Details." This plan was forwarded to the Officers in Charge, Marine Inspection, having jurisdiction over shipyards constructing Liberty ships on March 13, 1944.

Plans are being prepared to cover the Liberty-type collier, Maritime Commission design EC2-S-EW1.

Existing Dry Cargo and Tank Ships

All Liberty-type existing dry cargo and tank ships, as well as vessels under construction on which the deck stringer plate has been welded to the sheer strake, shall be subject to the following:

1. "Specifications for Alterations to Liberty Type Dry Cargo Ships and Liberty Ships Converted to Tankers," dated February 8, 1944, and forwarded to all Officers in Charge, Marine Inspection, coastal ports, on February 16, 1944.

2. Coast Guard Plan MI 14-S11-17-1 "Liberty Type Dry Cargo Ships and Tankers—Structural Reinforcements." This plan was forwarded to all Officers in Charge, Marine Inspection, coastal ports, on February 16, 1944.

3. In connection with Detail A of MI 14-S11-17-1, diagonal braces shall be fitted between the lower flanges of the hatch side and end girders. These diagonals are shown on Maritime Commission Plan EC2-S-C1-S16-2-3, detail No. 3. Prints showing this detail were forwarded to all Officers in Charge, Marine Inspection, coastal ports, on March 13, 1944.

4. As an alternate to cutting the sheer strake and fitting a strap as indicated on Coast Guard Plan MI 14-S11-17-1, Detail C, the stringer plate may be cut and a riveted gunwale angle fitted in accordance with Maritime Commission Plan No. MCE S11-6-4B, "Details of Gunwale Angle—Deck Scuppers, etc., for Existing EC2-S-C1 Cargo Vessels." This plan was forwarded to all Officers in Charge, Marine Inspection, coastal ports, on February 16, 1944.

5. An alternate and more desirable scupper arrangement has been prepared and is shown on War Shipping Administration Drawing No. MR 15-S48-8-1, "Under Deck Scuppers." Copies of this plan were forwarded to all Officers in Charge, Marine Inspection, coastal ports, on March 13, 1944.

An especial plan MC No. Z-ET1-C3-S16-2-3 has been prepared covering the reinforcement of the corners of the expansion trunks on the tanker conversion. The diagonal braces described under item No. 3 are not to be fitted on the tank vessels.

Specifications for Alterations to Liberty-Type Dry Cargo Ships and Liberty Ships Converted to Tankers

The following specifications were mutually agreed upon by the Maritime Commission, the Coast Guard and the American Bureau of Shipping on February 8, 1944.

All Liberty cargo ships and Liberty vessels converted to tankers presently in service shall have the structural alterations made at the time, indicated above, and in the manner described herein, and shown on Coast Guard Plan MI 14-S 11-17-1 and Maritime Commission Plan MCE S11-6-4B.

A. Hatch Corner Reinforcement.—On vessels where a rounded reinforcement has not already been fitted, the corners of Nos. 2, 3 and 4 hatches on the upperdeck shall be reinforced in accordance with Detail A of Drawing MI 14-S11-17-1.

B. Upper Deck Alteration.—A torch cut shall be made port and starboard in the upper deck plating 28 in. outboard of the line of the hatch side coaming extending from frame No. 40 to No. 144½. The torch cut is to be covered with a double riveted strap in accordance with Detail B of Drawing MI 14-S11-17-1.

C. Gunwale Alterations.—One of the following alternate arrangements shall be provided:

1. A torch cut shall be made in the stringer plate about 1 in. from the sheer plate and extending from frame No. 28½ to No. 144½. The torch cut is to be covered

by a 7 x 6 in. riveted gunwale angle fitted in accordance with MCE Plan S11-6-4B; or,

2. A torch cut shall be made in the sheer strake below the upper deck plating extending from frame No. 28½ to No. 144½. The torch cut is to be covered with a double-riveted seam strap in accordance with Detail C on Drawing MI 14-S11-17-1.

D. Bilge Keel.—For vessels, which have continuously welded bilge keels, a 1-in. hole is to be drilled tangent to the shell in way of each butt in the bilge keel. This is to be done at the time of the first docking of the vessel after issuance of this instruction.

Existing Troop Ship Conversions

All Liberty-type vessels converted or being converted to troop ships shall be subject to the following:

1. "Proposed Specification for Alterations to Liberty-type Troop Ship Conversions," dated February 22, 1944, and forwarded to all Officers in Charge, Marine Inspection, coastal ports, on February 23, 1944.

2. Coast Guard Plan MI 15-S11-17-1, "Liberty-type Troop Ship Conversion—Structural Reinforcements." This plan was forwarded to all Officers in Charge, Marine Inspection, coastal ports, on February 23, 1944.

3. In connection with Detail A of MI 15-S 11-17-1, diagonal braces shall be fitted between the lower flanges of the hatch side and end girder. These diagonals are shown on Maritime Commission Plan EC2-S-C1-S16-2-3, Detail No. 3. Prints showing this detail were forwarded to all Officers, in Charge, Marine Inspection, coastal ports, on March 13, 1944.

4. As an alternate to cutting the sheer strake and fitting a strap as indicated on Coast Guard Plan MI 15-S11-17-1, Detail C, the stringer plate may be cut and a riveted gunwale fitted in accordance with Maritime Commission Plan MCE S11-6-4B, "Details of Gunwale Angle—Deck Scupper, etc., for Existing EC 2-S-C1 Cargo Vessels." This plan was forwarded to all Officers in Charge, Marine Inspection, coastal ports, on February 16, 1944.

5. An alternate and more desirable scupper arrangement has been prepared and is shown on War Shipping Administration Drawing No. MR 15-S48-8-1, "Under Deck Scuppers," copies of which were forwarded to all Officers in Charge, Marine Inspection, coastal ports, on March 13, 1944.

Proposed Specification for Alteration to Liberty-Type Troop Ship Conversions.

The following specifications which were mutually agreed upon by the War Department, Maritime Commission, American Bureau of Shipping and the Coast Guard, were set down on February 22, 1944, and do not apply to Liberty-type hospital ships.

All Liberty-type troop ship conversions presently in service shall have the structural alterations made at the time indicated above, and in the manner described herein and shown on Coast Guard Plan MI 15-S11-17-1 and Maritime Commission Plan MCE S11-6-4B.

A. Hatch Corner Reinforcement.—On vessels where a rounded reinforcement has not already been fitted, the corner of Nos. 2, 3 and 4 hatches on the upper deck shall be reinforced in accordance with Detail A of Coast Guard Plan MI 15-S11-17-1.

B. Upper Deck Alteration.—A slot 2½ in. wide shall be made in the upper deck plating. The location of this slot and the arrangement of the triple-riveted strap to be used in connection with it shall be in accordance with Detail B of Coast Guard Plan MI 15-S11-17-1.

C. Gunwale Alteration.—One of the following alternate arrangements shall be provided:

1. A torch cut shall be made in the stringer plate about 1 in. from the sheer plate and extending from frame No. 28½ to No. 144½. The torch cut is to be covered by a 7 x 6-in. riveted gunwale angle fitted in accordance with Maritime Commission Plan MCE S11-6-4B; or,

2. A torch cut shall be made in the sheer strake below the upper deck plating extending from frame No. 28½ to No. 144½. The torch cut is to be covered by a seam strap in accordance with Detail C on Coast Guard Plan MI 15-S11-17-1. This strap is to be 18 x 1 in. between frames No. 68 and No. 108. The strap is to be 16 x ¾ in between frames No. 28½ and No. 68 and between frames No. 108 and No. 144½.

D. Bilge Keel.—For vessels which have continuously welded bilge keels, an oval opening is to be cut tangent to the shell in way of each butt in the bilge keel and as indicated in Detail D on Coast Guard Plan MI 15-S11-17-1. This is to be done at the time of the first docking of the vessel after issuance of this instruction.

E. Double Bottom Girders.—Additional intercoastal girders shall be fitted in the double bottom, port and starboard, as follows:

1. A full depth girder 15.3-lb. plate 6 ft. 4 in. off centerline between frames No. 46 and No. 92 and then angling in to 5 ft. 6 in. off the centerline at frame No. 96. This ties into existing girder forward and into the engine girder aft.

2. A half depth girder 15.3-lb. plate 18 ft. 6 in. off the center line between frames No. 46 and No. 108. This ties into existing girders forward and a bracket is to be fitted aft of frame No. 108 extending aft at least three frame spaces.

F. Existing and New Deck Openings.—Especial care shall be executed to eliminate discontinuities and notch effects in the vessel's structure. The deck openings for all companions, ventilators, etc., shall be properly rounded. All bulwark openings shall be rounded and ground smooth. Companions and ventilator openings where possible shall be kept inboard of the line of hatches.

Existing Hospital Ship Conversions

All Liberty-type vessels converted or being converted to hospital ships shall be subject to the following:

1. Coast Guard Plan MI 16-S11-17-1, "Liberty Type Hospital Ship Conversions—Structural Reinforcements," which was forwarded to New York on March 9, 1944, and to Boston on March 11, 1944.

2. For vessels now under conversion and on which the work has already progressed too far to provide a deck arrestor in accordance with the above-mentioned plan, the details of the deck arrestor to be fitted are shown along with the other reinforcements on War Department, Transportation Corps, Water Division Plan LI-68-A-R1.

3. As an alternate to cutting the sheer strake and fitting a strap as indicated on Coast Guard Plan MI 16-S11-17-1, Detail C, the stringer plate may be cut and riveted gunwale angle fitted in accordance with Maritime Commission Plan MCE S11-6-4B, "Details of Gunwale Angle-Deck Scupper, etc., for Existing EC2-S-C1 Cargo Vessels." This plan was forwarded to all Officers in Charge, Marine Inspection, coastal ports, on February 16, 1944.

4. An alternate and more desirable scupper arrangement has been prepared and is shown on War Shipping Administration Drawing No. MR 15-S48-8-1, "Under Deck Scuppers," copies of which were forwarded to all

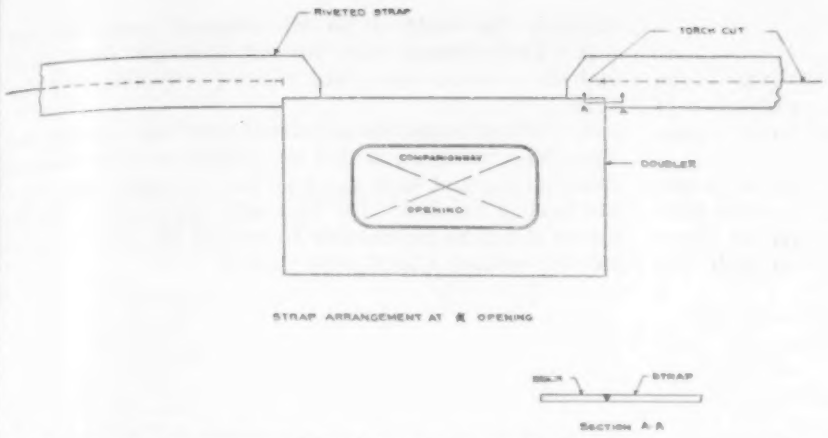


Fig. 11—Alternate Arrangement of Deck Strap in Way of Companionway at Frames 93 to 95

Officers in Charge, Marine Inspection, coastal ports, on March 13, 1944.

RELAXATIONS AND NOTES

General

1. In making these alterations, it is suggested that the tanks of the vessel be ballasted so that the ship is in a nearly neutral condition from the standpoint of longitudinal bending.

2. The shipyards making the alterations shall be careful not to have too great a length of cut on deck or at the gunwale or in the sheer strake in advance of fitting the required straps.

3. Vessels are not classed as troopships for these alterations unless the entire ship is fitted for troops.

Hatch Corner Reinforcement

1. The hatch corner reinforcement devised for new vessels (Maritime Commission drawing EC2-S-C1-S16-2-3—Detail 2) involves fitting an insert plate and doubler both slotted through the hatch coaming and cut to a 1 ft. radius on the inside. This type of reinforcement is not acceptable for existing vessels. An insert plate should not be introduced at a hatch corner of an existing vessel except in repairing damage. Even this should be avoided if possible by repairing the crack with welding (see Marine Inspection Memorandum No. 64).

2. If in repairs it becomes necessary to remove the 51 lb. doubler at the hatch corner, it need not be replaced in reinforcing the corner.

3. Not all Liberty ships have an insert plate at the hatch corner.

4. On some Liberty ships the 51 lb. doubler is above the deck.

5. Some of the newer vessels have already had their hatch corners reinforced during construction and no additional hatch corner reinforcement should be provided on such vessels. One of the approved types of reinforcements should be found in or placed in the corners of Nos. 2, 3 and 4 hatches in the upper deck of every Liberty ship.

Upper Deck Alterations

1. The deck strap shown on Maritime Commission Plan EC2-S-C1-S11-6-6 and Coast Guard Plans MI 14 and 15-S11-17-1 may be stopped at frame No. 40 instead of running to frame No. 39 as it is shown on the plans. This relaxation was made on all new and existing vessels because the additional assurance gained by running this strap forward one additional frame space does not warrant the expense and delay incurred by interference with the sounding tubes at frame No. 39.

2. The deck strap on the troop ships may be increased in width from 16 to 19 in. if this appears desirable in order to avoid the close spacing of the triple rows of zigzag riveting indicated on Coast Guard Plan MI 15-S11-17-1.

3. Permission has been granted to allow the slot in the deck to stop at the edge of the doubler around the companionway at frame No. 93 to No. 95 and to weld the 16 x 3/4-in. strap thereto, provided that rounded reinforcements with face plates are fitted in the corners of the companions so that the companion will have the strength to arrest a fracture which might cross the deck in this region, see Fig. 11. This alteration may be permitted on new vessels, and existing dry cargo ships, tank ships and troop ships of the Liberty type. A specification which could be used as a general guide in reinforcing deck openings of this nature was forwarded to Coast Guard Merchant Marine Inspection offices with Headquarters' letter of April 10, 1944.

4. As an alternative to the above for the companionway at frames No. 93 and No. 95, the companionway doubler may be trimmed back on the inboard edge so that it clears the outboard edge of the deck strap. The seam between the doubler and strap should then be welded with a deep V weld.

5. At other points if companionways lie in the path of the deck strap the cut should be carried right into the opening and its athwartship location should be altered by splaying outboard or inboard over a distance of not less than 4 frame spaces so that it enters the opening not less than 8 in. from the corner, see Fig. 12. Tapered liners should be used to carry the strap over existing doublers but if the deck is cut for the crack arrestor before fitting the companion doubler (as for a new companionway) the ends of the strap may then be welded to the edge of the doubler. In any case the cut must go into the companionway.

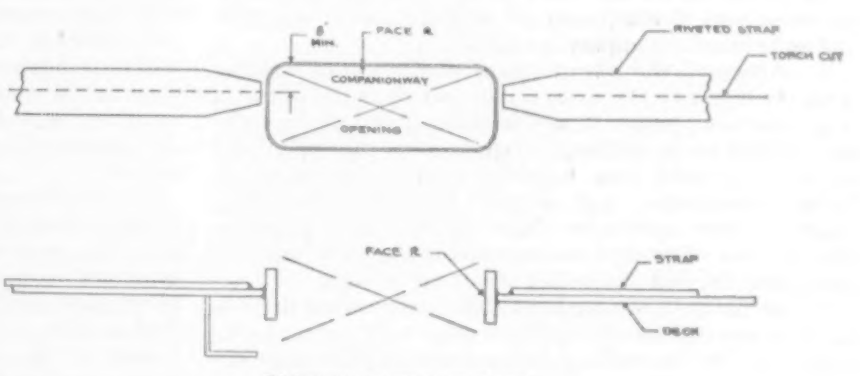


Fig. 12—Arrangement of Deck Strap Where It Falls in Line with Companionway

Gunwale Alteration

1. It is left to the local authorities to determine on the basis of economy of time and money and availability of materials whether it will be more practical to fit a gunwale bar or a strap on the sheer strake.

2. The heel of the gunwale angle may not be chamfered to a radius of more than $^3/_8$ in. to ride over the fillet weld at the gunwale. If the weld (stringer to sheer strake) is too large to permit a proper fit-up with this chamfer the weld is to be chipped away to suit.

3. Deck drains may be cut through sheer strake and sheer strake strap but regular scuppers are preferable.

4. Where scuppers are fitted and the existing deck drain hole has been sealed by a light weld between the sheer strake and new gunwale bar or sheer strap there has been a tendency for this weld to crack. For this reason it will be permissible to seal off the old deck drain hole by welding a light plate over it.

Design and Methods of Construction of Welded Steel Merchant Vessels*

1. The precept of the Board to Investigate the Design and Methods of Construction of Welded Steel Merchant Vessels requires an investigation and report. It was evident that ship failures which gave rise to the appointment of the Board were already of concern to the agencies represented by the Board. Some remedial measures had been taken before the Board was formed. Additional remedies have been ordered since that time. This report will include mention of corrective action taken, along with the results of investigation and the Board's opinion.

2. The use of welding in lieu of riveting in ship construction has a considerable history. It had an immediate appeal to the designer of naval vessels because it offered a direct means for saving hull weight. Elimination of plating and structure represented by seam laps, butt straps and faying flanges, necessary for rivets, was obvious and direct. On a given ship displacement, this saved weight could be devoted to battery, armor or other military load. The limitations on displacement imposed by the Washington and London Naval Treaties became impelling incentives to make use of light materials and welding to save weight so that a larger proportion of displacement could go into military load. The superior behavior of welded structure in way of explosion forces also became apparent. The force of these advantages made it natural for the Navy to lead the way in the application and development of welding tools, materials and procedures as applied to ships.

3. Although the advancement of the use of welding from the lesser to the more important elements of naval ship structure could not be scheduled ahead of the technical advances in welding, progress from the early '20's up to the present time has been fairly uniform, necessarily conservative and entirely free from disastrous failure. Large combatant ships still contain a considerable number of riveted connections in carefully selected joints and the end of riveting is not yet in sight.

4. In the field of merchant ship construction there is an economic incentive to produce ships with lighter hulls, made possible by welding, because the displacement devoted to cargo can be increased. The additional advantages of tightness of structure and lower maintenance cost are also realized. The character of marine risks has created a powerful, conservative force against change. Until about 1936 the application of welding to merchant ship construction was almost entirely limited to small ships and barges. From 1936 to the beginning of the war the welding of large ships was not widespread. It is interesting to note, however, that even before 1936 a few pioneers in welded merchant ship construction advanced much farther than the Navy in capitalizing the advantages afforded by welding. These advances were in the direction of shop and slab welding of large subassemblies and in the use of automatic welding.

5. War expansion of shipbuilding facilities brought into existence many completely new yards. It was accepted that welding art, design and performance had developed to the point where completely welded ships were practical and fast to build. Equipping the new yards primarily for welding and with reduced fabricating tools, air compressors, piping systems, rubber air hose and pneumatic tools required for riveting operations was an important factor in the relief of man power, toolmaking capacity and in time. These considerations influenced the decision to accept the welded hull for large merchant ships.

6. The classification societies and the Bureau of Marine Inspection and Navigation reached the conclusion that experience already gained with welded hulls was sufficient to warrant this extension of the practice without undue risk. Experience has shown that the war program of merchant ship construction could not have been accomplished on the necessarily large scale if the advantages of welding had not been utilized to the fullest extent.

7. At the same time, the Navy realized that, as the volume of ships and craft of a type to be built increased from the peacetime few to wartime hundreds, the usual practices of shipbuilding would have to give way to line production methods. Complete welding was the natural answer to this demand. The resulting all-welded vessels of the landing craft and destroyer escort programs paralleled the small all-welded merchant vessels in having outstandingly successful performance.

8. In contrast with the performance of small naval

* Interim Report of a Board of Investigation convened by order of the Secretary of the Navy to inquire into the design and methods of construction of welded steel merchant vessels, June 3, 1944.

and merchant craft, the larger merchant vessels have experienced, in certain cases, some structural difficulties resulting in fractures in the plating.

9. The scope of the investigation necessary to survey the possible defects which have led to the fracture of ship structure afloat is very large. It involves:

A. Historical Study of Recent Hull Fractures.
   1. Statistical analysis.
   2. Specific cases.
B. Design.
   1. General.
   2. Detail.
   3. Full-scale tests.
C. Materials.
   1. Base metal.
   2. Welding electrodes.
D. Construction.
   1. Procedures (fitting and edge preparation—welding techniques and welding and erection sequences).
   2. Supervisors, inspectors, and workers.
E. Operating Conditions.
   1. Loading.
   2. Ballasting.
   3. Weather.
   4. Course, speed and sea routes.
F. Specific Investigations.
G. International Exchange of Information.

A. Historical Study of Recent Hull Fractures

1. Statistical Analysis

On the basis of authenticated reports received on a representative group of 2993 ships, fractures have occurred after launching on about 577 occasions to 432 ships up to April 1, 1944. A large proportion of these were minor in character. In the case of about 95 ships the fractures were potentially serious in that they extended well into the ship girder. Twenty vessels have suffered complete fractures of the strength deck and, of these twenty, five have completely broken in two. Two of these complete fractures occurred on vessels still at the builders' yards prior to the vessel's being placed in service. Both of these vessels and one of the others which suffered a complete break after being in service have been repaired. Four of the vessels which suffered complete fractures of the strength deck but which had not been completely severed were abandoned so that only six vessels can be said to have been definitely lost to service from structural failures.

No lives have been lost as the result of structural failures, except in the case of the *John P. Gaines* where ten persons are missing after successfully embarking in a lifeboat.

Cracking in ships afloat has usually been associated with near freezing temperatures, or heavy seas, or combinations of these two conditions.

New fractures continue to develop but statistical data for ships afloat are insufficient as yet to indicate definitely the effect of corrective measures which have been taken. There is other evidence, however, that the incidence of fractures in new vessels while on the building ways has been materially reduced.

The statistical analysis shows that practically all fractures originate in discontinuities occasioned by design details and notch effects incidental to imperfect welding.

Contrary to popular impression, hull fractures are not confined to Liberty ships but are shared by other types of vessels.

2. Specific Cases

Appended are narrative accounts of the breaking in two of four of the five vessels mentioned in paragraph A, 1 and the account of one vessel typical of the fifteen ships which suffered complete fracture of the strength deck.

B. Design

1. General

The scantlings of all affected classes of vessels have been re-examined and are found to have a margin of strength over the requirements of internationally accepted standards.

For service which involves many long voyages in ballast, the general design of future cargo ships should include provision for adequate amounts and proper distribution of liquid ballast.

It is generally accepted that the behavior of structure in the immediate vicinity of a welded joint will differ from that in way of a riveted joint because of the presence of rivet holes and the possibility of slippage in riveted joints. The configuration of riveted joints is usually different from welded joints and this may be a further contributing factor. The degree of importance of these differences in structural behavior is under investigation, with particular emphasis on stress-strain characteristics of various welded joints.

2. Detail

The evidence so far revealed has shown that attention to detail design to minimize notch effects of square corners and other discontinuities which has been recognized as good practice in riveted ship design, is of even greater importance in the design of welded ships. Improvements in this direction are current in unfinished construction and in all new ship designs. Directives have been issued and progress is being made toward their accomplishment in ships in service. Research is in hand at government and university laboratories to explore the character of notch effect in order to guide the continued refinement of design.

Pending the accumulation of greater knowledge resulting from service experience and research as to the origin and propagation of cracks, careful consideration should be given in new welded ship designs to the provision of means for arresting the progression of cracks once started. In the case of the Liberty ships, directives have been issued for the installation of four longitudinal riveted joints in the strength deck through the mid-length for this purpose. Work is progressing as rapidly as military considerations permit.

3. Full-Scale Tests

Full-scale hogging and sagging tests, coupled with strain measurements, have been made on five ships, one T-2 tanker and four L-6 ore carriers. The resulting data serve to confirm earlier tests and the generally accepted agreement between calculations with the assumptions on which they are based on the one hand and the actual ship stress on the other. A full-scale hogging and sagging test is presently being undertaken on a Liberty (EC-2 cargo) ship.

C. Materials

1. Base Metal

Records show that all but an insignificant portion of the steel used in the hulls of welded merchant vessels meets existing specifications for quality. In the few

cases where steel has been shown to fall outside the specification requirements, this fact has not been determined to contribute to the fractures. Investigations have been initiated to explore properties not now covered by specifications with a view to improvement of material performance.

2. Welding Electrodes

There is no evidence that fractures in ships afloat have been caused by the inadequate quality of welding electrodes. Despite the pressure of the war emergency the quality and uniformity of welding electrodes have, in general, been maintained and, in some cases, improved through the cooperation of the producers. Investigations looking toward further improvement are being continued.

D. Construction

Construction methods and quality of workmanship are major factors in the success or failure of welded hull structures. Some welded ships have sustained fractures while on the building ways whereas such fractures are not experienced with riveted hulls on the ways. This is accounted for in part by specific construction practices. In some cases similarity in the character and location of fractures in ships afloat to those which occur in ships on the ways has been observed, thus indirectly indicating faulty practices as a contributing cause of fracture. In other cases fractures in ships afloat have been directly attributable to faulty practices.

Recognized good practice has been shown to reduce materially the number of fractures in ships while on the ways. The means of achieving good practice are discussed, in general, in the following.

1. Procedures (Fitting and Edge Preparation—Welding Techniques and Welding and Erection Sequences)

The planning and execution of procedures and sequences for welded ship construction in conformance with recognized fundamentals of good practice is essential. This planning must cover the ship as a whole as well as the details of its parts. Adequate planned procedures and sequences have been available to the shipyards. The work at the University of California (see paragraph F) is pointed toward a better understanding of the basic fundamentals of good practice and of the importance and the effects of residual, "locked-up" or "shrinkage" stresses.

At the beginning of the war emergency there was general disregard by the yards of planned procedures and sequences wherever they appeared to interfere with rapid production. Subsequent to January 1943 there has been considerable improvement in this attitude through education and recognition of the serious consequences resulting from unplanned work. Further coordination of the efforts of shipfitters and welders will contribute to additional improvements. Where production pressure makes departures from the plan mandatory a new plan for local application should be developed to avoid violation of fundamental principles. A sufficient number of competent supervisors, inspectors and workers is essential for the execution of the plan.

2. Supervisors, Inspectors and Workers

The number of competent members of these groups has been quite inadequate and the situation does not show any appreciable improvement as intensive programs of recruitment and training have been largely offset by the rapid growth of the industry, the large labor turnover, the demands of Selective Service and the necessity for high-speed production in the war effort.

E. Operating Conditions

1. Loading

Military requirements sometimes result in a loading which is less favorable to the ship, with respect to minimizing stresses in a seaway, than normal peacetime practice. The vessels, in some cases, are loaded deeper than in ordinary times and heavy deck loads are not uncommon. Although the amount and distribution of cargo always influence ship stresses, no structural fractures can be traced directly to the character of loading as the primary cause.

2. Ballasting

Ships generally have not been more subject to fractures when in ballast than when loaded. Certain ballast conditions, in association with relatively light draft, resulting in comparatively large hogging moments, appear however, to produce conditions favorable to the progression of cracks once started. Of the 20 ships which have broken in half or sustained complete fracture of the strength deck, 16 were in ballast and two were loaded. The remaining two of the group of 18 which failed at the builder's dock prior to going into service were adversely ballasted although not abnormally so.

3. Weather

As noted in paragraph A, 1 a large proportion of fractures occurred during conditions of low temperature, heavy seas or combinations of these two conditions. Fifteen of the twenty ships which suffered severe damage were in heavy seas.

4. Course, Speed and Sea Routes

Convoy operation necessarily limits the master in choosing course and speed in heavy seas that would favor his ship. War operations have resulted in routing large numbers of ships over sea routes through colder and rougher ocean areas than was the case in peacetime.

In summation, adverse combinations of loading or ballasting, heavy seas and low temperature are factors contributing to structural distress. Of these factors only loading and ballasting are subject to control, course and speed being subject to only limited control while in convoy. Instructions have been issued in the case of Liberty ships, where the permanently installed arrangements for liquid ballast were not the most favorable, to insure a better distribution of ballast when conditions permit.

F. Specific Investigations

The following projects of inquiry have been initiated and are being pressed to the earliest possible conclusion:

(*a*) Statistical analysis of steel mill products aimed at assisting the mills to obtain improved and uniform products. This subject is headed by the Bureau of Ships and contributed to by the mills, private and government laboratories.

(*b*) Research to show the relationship between temperature and notch sensitivity in killed, semikilled and rimming steels at the National Bureau of Standards.

(*c*) "Study of the behavior of steel under conditions of multiaxial stress and the effect on this behavior of metallographic structure and chemical composition." National Defense Research Project No. NRC-77, which is being conducted by the Armour Research Foundation

under the guidance of the War Metallurgy Committee (Navy Project No. NS-307).

(*d*) "Behavior of steel under multiaxial stress and the effect of welding and temperature on this behavior." National Defense Research Council Project No. NRC-75, which is being conducted by the University of California under the guidance of the War Metallurgy Committee (Navy Project No. NS-306).

(*e*) "Residual stress in ship welding." National Defense Research Project No. NRC-64, which is being conducted by the University of California under the guidance of the War Metallurgy Committee (Navy Project No. NS-304).

(*f*) "History of residual stresses in welded ship hulls of the Liberty and oil tanker types." National Defense Research Project No. NRC-74, which is being conducted by the University of California under the guidance of the War Metallurgy Committee (Navy Project No. NS-305).

(*g*) Experiments in strength of welding, which are being conducted by the Illinois Institute of Technology.

(*h*) Photoelastic study of various means of hatch corner reinforcement, which is being conducted by the David Taylor Model Basin.

(*i*) Study of various types of crack arrestor by small scale models, conducted by David Taylor Model Basin.

(*j*) Crack arrestor study with large models, which is being performed at the University of Illinois.

(*k*) Weldability of steel for hull construction, NDRC No. NS-255 at Lehigh University.

G. International Exchange of Information

Information on structural experience is being exchanged with governments of allied nations which operate American-built welded merchant vessels. The British government has organized a permanent unit known as the "Admiralty Ship Welding Committee" to study both merchant and naval ship welding problems. Information is being exchanged with this body.

Summary

In 2561 of the 2993 large welded merchant vessels of the total Maritime Commission program in service up to April 1, 1944, no fractures subsequent to launching have been reported. In the remaining 432 ships, fractures which were potentially serious occurred in 95, of which six resulted in the loss of the vessel. Analysis of the fractures indicates the existence of phenomena in welded construction which may be of importance and to which a long and satisfactory experience of riveted construction affords no reliable guide. They include such factors as shrinkage stresses built into the hulls by the welding process, the behavior of steel at low temperatures and the stress-strain characteristics inherent in the locally more rigid welded structure. A large number of research projects have been initiated and are now under way in order to determine the relative importance of these factors and with a view to determining what steps should be taken in design and in construction methods to eliminate or reduce such deleterious effects as may be found. Basically, the abnormal conditions of wartime shipbuilding and ship operation, construction practices largely incidental to speed of production and structural design details, are factors which in large measure have contributed to the occurrence of fractures. Appropriate steps have been taken to improve the two latter conditions where control is feasible but such corrective measures have not been in effect long enough to be able to state definitely at this time that they will prove completely effective.

In closing this preliminary report, the Board considers it important to record its opinion that without an early and general adoption of welded construction in the merchant shipbuilding program, as well as in the naval shipbuilding program, the results in speed and volume of construction which have been accomplished would have been impossible.

/S/ Harvey F. Johnson, Rear Admiral, U.S.C.G.
/S/ E. L. Cochrane, Rear Admiral, U.S.N.
/S/ H. L. Vickery, Rear Admiral, U.S.N.
/S/ David Arnott, Vice-President, Chief Surveyor, American Bureau of Shipping.

Editorial Note:

Photostatic Copies of the Original reports on the S. S. Schenectady, the S. S. Esso Manhattan, the S. S. John P. Gaines, the S. S. Valery Chkalov and the S. S. Samuel Dexter are reproduced on the following pages.

REPORT OF STRUCTURAL FAILURE OF INSPECTED VESSEL
UNITED STATES COAST GUARD
NAVCG-2752

This report includes all available information up to: 1 April, 1944 (Date)

DESCRIPTION OF VESSEL

NAME	OFFICIAL NO.	TYPE	M.C. DESIGN
SCHENECTADY	242620	Tank Vessel	T2-SE-A1
BUILDER		**BUILDER'S HULL NO.**	**DATE COMPLETED**
Kaiser Co., Inc., Portland, Ore.		#1	31 Dec. 43
OWNER		**OPERATOR**	
War Shipping Administration		Deconhill Shipping Company	

EXTENT OF WELDING

Hull all welded
No inner bottom

Yes SIDE SHELL SEAMS	Yes BOTTOM SEAMS	☐ INNER BOTTOM SEAMS	Yes DECK SEAMS
Yes SIDE SHELL BUTTS	Yes BOTTOM BUTTS	☐ INNER BOTTOM BUTTS	Yes DECK BUTTS
Yes FRAMES TO SIDE SHELL	Yes FLOORS TO SHELL	☐ FLOORS TO INNER BOTTOM	Yes BEAMS TO DECK
Yes BULKHEADS			Yes DECK TO SHELL

CIRCUMSTANCES SURROUNDING FAILURE

(Attach all available details of ship's loading)

DATE OF FAILURE	TIME	SHIP'S LOCATION	
16 Jan., 1943	2230 PWT	Tied up at fitting out pier, Swan Island	
SHIP'S SPEED	**COURSE**	**DRAFT FWD.**	**DRAFT AFT**
0		6'-4"	17'-0"
SEA CONDITION	**WEATHER**	**DIRECTION OF WAVES WITH RESPECT TO SHIP**	
Still water	Clear	No waves	
WIND FORCE	**WIND DIRECTION**	**AIR TEMPERATURE**	**WATER TEMPERATURE**
Light	East wind	26° F	40° F

DESCRIPTION OF FAILURE

(Include sketch of fracture showing starting point and relative location of welds and other structural features)

APPARENT STARTING POINT: The fracture started at the juncture of the fashion plate at the aft starboard corner of the bridge superstructure and the sheer strake.

GENERAL HISTORY AND DESCRIPTION OF FAILURE, INCLUDING KNOWN CONTRIBUTORY FACTORS:

Without warning and with a report which was heard for at least a mile, the deck and sides of the vessel fractured just aft of the bridge superstructure. The fracture extended almost instanteously to the turn of the bilge port and starboard. The deck side shell, longitudinal bulkheads and bottom girders fractured. Only the bottom plating held. The vessel jack-knifed and the center portion rose so that no water entered the hull. The bow and stern settled into the silt of the river bottom. Sounding taken around the vessel eliminated the alleged possibility of the vessel having grounded amidships due to a drop in water level. A slight earth tremor was alleged to have occurred at the time of the casualty. The steel of the sheer strake was slightly below specification in yield point and ultimate strength. The deck stringer was low in yield point. Both steels were notch sensitive at low temperature, but there is no existing specification for this characteristic. The welds between the fashion plate and the sheer strake and between the sheer strake and stringer plate were found to contain defects.

CLASSIFICATION OF FAILURE: Broke in two

DISPOSITION OF VESSEL

Repaired, lost, etc.

Vessel repaired and put in service.

SIGNED (Name and Title)

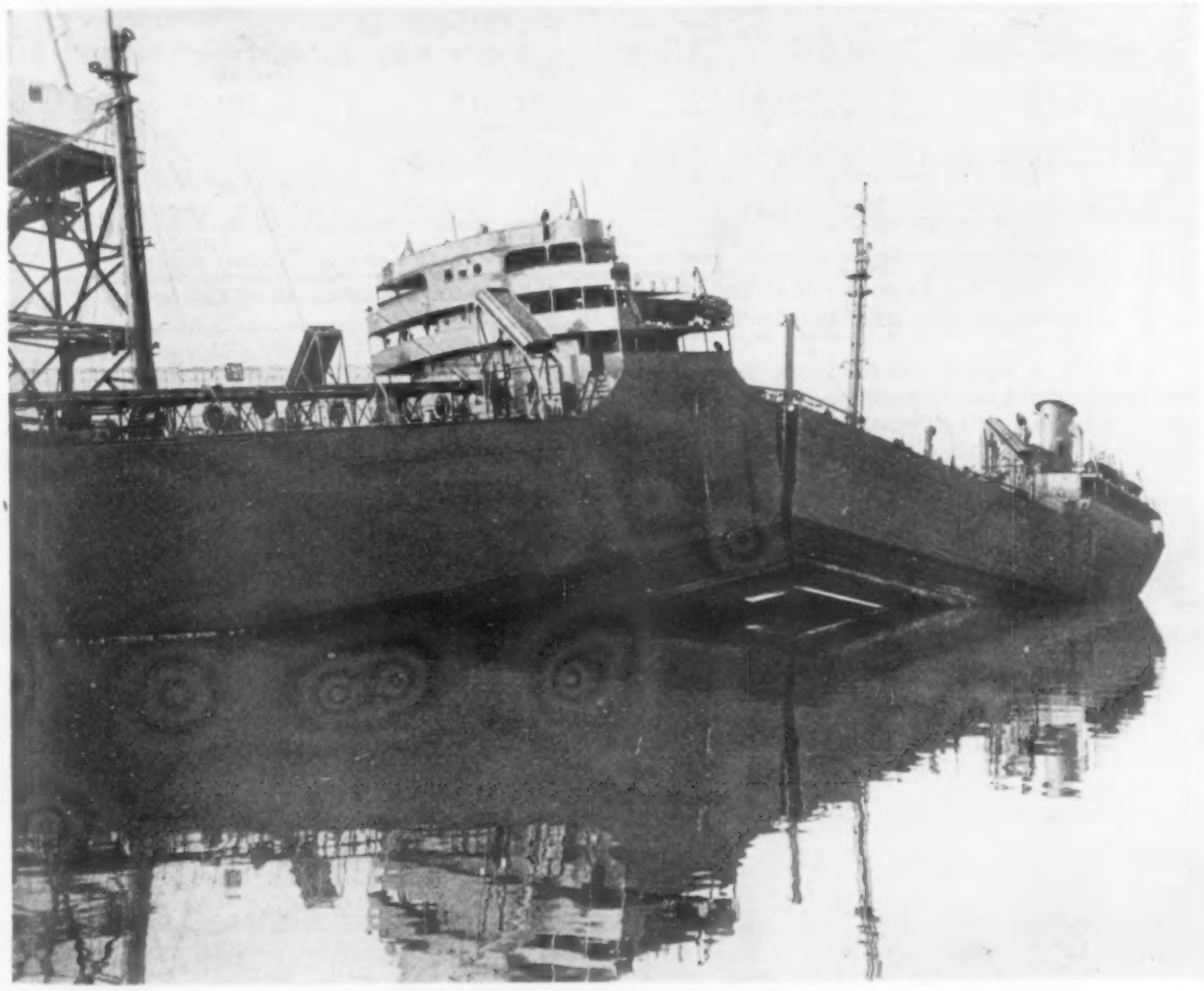
See reverse side for loading details.

LOADING AT TIME OF FAILURE

Distribution of Weights

Forepeak	314	Long tons
Cargo tanks	0	
F.W. Tanks	71	
F.O. Bunkers Fwd.	745	
F.O. Bunkers in E.R.	486	
I.B. Tank 11-27 P. & S.	73	
I.B. Tank 27-44 P. & S.	166	
Ammunition Ford.	20	
Ammunition Aft	10	
Dist.Water Tank	36	
F.W. Tank Aft	29	
Aft Peak	56	
Lightship	5202	
Stores & Complement	40	
Displacement	7230	Long tons
Corresponding Keel Drafts	7.0'	Frd.
	15.2'	Aft

On the basis of the loading indicated to the left, bending moment calculations were made. The uniform calculated stress in the crown of the deck in still water is 10,700 lbs./in.^{2}



S.S. Schenectady

REPORT OF STRUCTURAL FAILURE OF INSPECTED VESSEL
UNITED STATES COAST GUARD
NAVCG-2752

This report includes all available information up to 1 April, 1944 (Date)

DESCRIPTION OF VESSEL

NAME	OFFICIAL NO.	TYPE	M.C. DESIGN
ESSO MANHATTAN	242157	Tank Vessel	T2-SE-A1
BUILDER		**BUILDER'S HULL NO.**	**DATE COMPLETED**
Sun Shipbuilding & Drydock Company		# 267	22 Aug. 42
OWNER		**OPERATOR**	
Standard Oil Co. of New Jersey		Standard Oil Co. of New Jersey	

EXTENT OF WELDING

Hull all welded
No inner bottom

Yes SIDE SHELL SEAMS			Yes DECK SEAMS
Yes SIDE SHELL BUTTS	Yes BOTTOM SEAMS	☐ INNER BOTTOM SEAMS	Yes DECK BUTTS
Yes FRAMES TO SIDE SHELL	Yes BOTTOM BUTTS	☐ INNER BOTTOM BUTTS	Yes BEAMS TO DECK
Yes BULKHEADS	Yes FLOORS TO SHELL	☐ FLOORS TO INNER BOTTOM	Yes DECK TO SHELL

CIRCUMSTANCES SURROUNDING FAILURE

(Attach all available details of ship's loading)

DATE OF FAILURE	TIME	SHIP'S LOCATION	
29 March, 1943	1205 EWT	40 fathoms of water 3/4 mile inshore buoy 3, Ambrose Channel, N.Y.	
SHIP'S SPEED	**COURSE**	**DRAFT FWD**	**DRAFT AFT**
14 knots	121° True	12'-1"	18'-7"
SEA CONDITION	**WEATHER**	**DIRECTION OF WAVES WITH RESPECT TO SHIP**	
Slight ground swell	Clear	On port bow	
WIND FORCE	**WIND DIRECTION**	**AIR TEMPERATURE**	**WATER TEMPERATURE**
Force 2	Northeast	30° to 40°	Not known

DESCRIPTION OF FAILURE

(Include sketch of fracture showing starting point and relative location of welds and other structural features)

APPARENT STARTING POINT The fracture started in a butt weld between plates A-9 and A-10 at the crown of the deck.

GENERAL HISTORY AND DESCRIPTION OF FAILURE, INCLUDING KNOWN CONTRIBUTORY FACTORS:

With a sound described variously as a thump, thud, bang, crash or explosion, the fracture ran across the deck in way of #6 tank, and down both sides, progressing to the bilge port and starboard. The vessel jack-knifed and the bow dug under an oncoming wave. The crew abandoned in the boats and were picked up by the USCG KIMBALL. The bottom fractured later and the two portions drifted apart. Subsequent examination and tests of the steel in the vicinity of the starting point and from each plate around the periphery of the hull near the fracture indicated that it met existing standards. The chemistry was normal for the class of steel. Impact and notch bend tests showed that much of the steel was sensitive to notches and low temperature. The butt-weld in which the crack started contained oxide, slag and porous areas.

CLASSIFICATION OF FAILURE: Broke in two.

DISPOSITION OF VESSEL

Repaired, lost, etc.

Repaired on drydock at Todd Erie Basin and returned to service.

SIGNED (Name and Title)

See reverse side for loading details.

LOADING AT TIME OF FAILURE

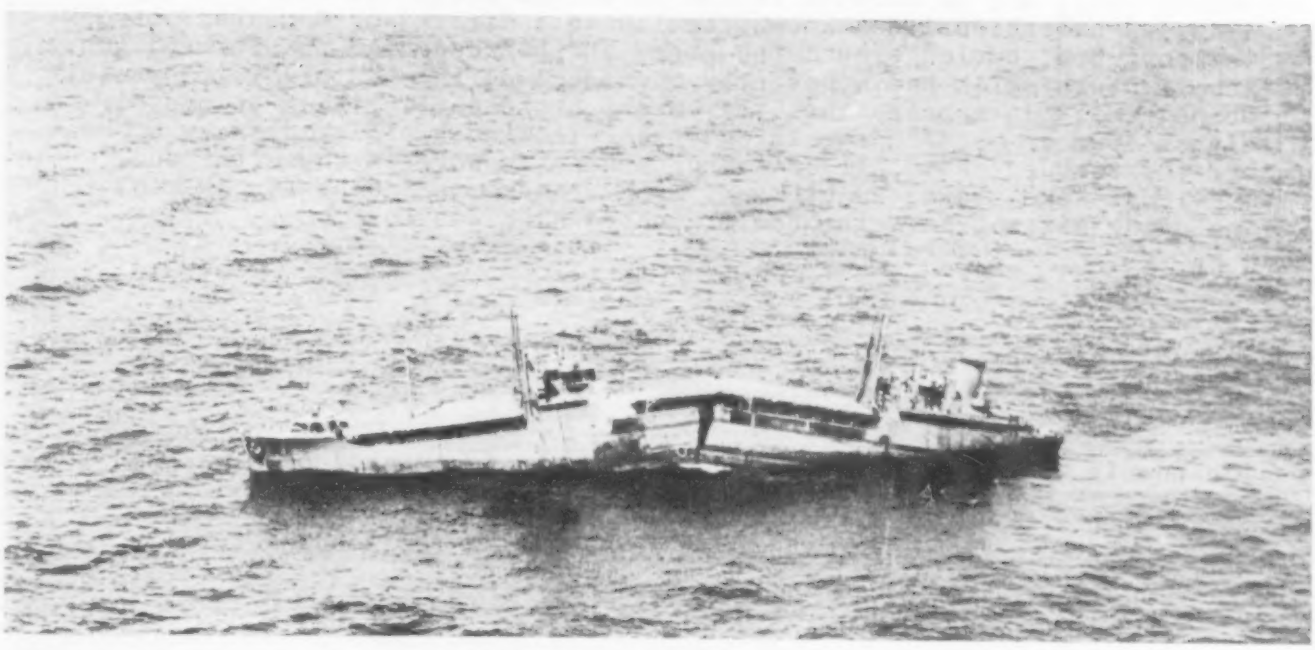
Distribution of Weights

Forepeak	314	Long tons
Cargo Tank #1 P	388	
S	388	
#2 P	6	
S	6	
Cl	1385	
#3 P	16	
S	16	
#4 P	20	
S	20	
#9 P	21	
S	21	
Cl	1330	
F.W. Tanks	70	
F.O. Bunkers	240	
F.O. Bunkers	240	
I.B. Tank 11-27 P	41	
I.B. Tank 27-44 P	82	
I.B. Tank 11-27 S	31	
I.B. Tank 27-44 S	84	
Dist. Water Tank	18	
F.W. Tank Aft	29	
Aft Peak	56	
L.O. Storage	2	
Lightship	5455	
Stores & Complement	65	
Displacement	10344	Long tons

Corresponding Keel Drafts
18'-6-5/8" Aft
12'-1-1/8" Fwd.

At the time of the failure, the tanks were reported to be in the condition shown to the left. This was checked after the two portions had been towed into port. The vessel was taking ballast in accordance with the Navy schedule but due to damaged valves in #7 and #9 tanks which valves were to be repaired on the outbound voyage the schedule was not being strictly followed. The ends of the vessel contained proportionately more ballast. The uniform calculated stress in the crown of the deck in still water and in the condition noted is 12,300 lbs. per sq. inch.

It should be noted that the vessel drafts were otherwise reported to be 15' Fwd. and 22'-8" aft, also 17'-6" Fwd. and 23' aft. It is believed that the calculated drafts (to left) based upon an accurate deadweight determination made in February, 1943 are more nearly correct.



S. S. *Esso Manhattan*

REPORT OF STRUCTURAL FAILURE OF INSPECTED VESSEL
UNITED STATES COAST GUARD
CG-2752

This report includes all available information up to: 1 April, 1944 (Date)

DESCRIPTION OF VESSEL

NAME	OFFICIAL NO.	TYPE	M.C. DESIGN
JOHN P. GAINES	243861	Dry Cargo Vessel	EC2-S-C1
BUILDER		**BUILDER'S HULL NO.**	**DATE COMPLETED**
Oregon Shipbuilding Corporation		# 723	8 July 43
OWNER		**OPERATOR**	
War Shipping Administration		Northland Transportation Co., Inc.	

EXTENT OF WELDING

Yes SIDE SHELL SEAMS			Yes DECK SEAMS
Yes SIDE SHELL BUTTS	Yes BOTTOM SEAMS	Yes INNER BOTTOM SEAMS	Yes DECK BUTTS
No FRAMES TO SIDE SHELL	Yes BOTTOM BUTTS	Yes INNER BOTTOM BUTTS	Yes FRAMES TO DECK
Yes BULKHEADS	Yes FLOORS TO SHELL	Yes FLOORS TO INNER BOTTOM	Yes DECK TO SHELL

CIRCUMSTANCES SURROUNDING FAILURE

(Attach all available details of ship's loading)

DATE OF FAILURE	TIME	SHIP'S LOCATION	
24 Nov., 1943	0241 #10 time zone	55-07 N 155-30W 40 miles bearing 175° true from Chirkoff Is.	
SHIP'S SPEED	**COURSE**	**DRAFT FWD.**	**DRAFT AFT**
9 knots	Dutch Harbor to Seattle, 76° true	13'-0"	10'-0"
SEA CONDITION	**WEATHER**	**DIRECTION OF WAVES WITH RESPECT TO SHIP**	
Long ground swell	Fairly clear	15°-20° off port bow	
WIND FORCE	**WIND DIRECTION**	**AIR TEMPERATURE**	**WATER TEMPERATURE**
5-6 Beaufort	ENE	40°-45° F	About 40° F

DESCRIPTION OF FAILURE

(Include sketch of fracture showing starting point and relative location of welds and other structural features)

APPARENT STARTING POINT

Near Fwd. corners #3 hatch between Frs. #74 and #75.

GENERAL HISTORY AND DESCRIPTION OF FAILURE, INCLUDING KNOWN CONTRIBUTORY FACTORS:

At about 2200 on 23 November, 1943, loud noises were heard but the source could not be located in the dark. At about 0241 on 24 Nov., 1943, an exceptional sea known locally as a "freak" or "sneaker" struck the port bow, curled around the stem, and boarded near the forward gun. The fracture which had apparently commenced during the night immediately propagated. It appears that the vessel broke partially as it passed either over or between swells and the following swell completely broke off the forward end. All crew and passengers were on the after end. Survivors were picked up by U. S. Army Transports except for 10 men, including six soldiers in one lifeboat, which was lost.

CLASSIFICATION OF FAILURE: Broke in two

DISPOSITION OF VESSEL

Repaired, lost, etc.

The bow is believed to have sunk. The stern is aground on Big Koniuji Island.

SIGNED *(Name and Title)*

See reverse side for loading details.

LOADING AT TIME OF FAILURE

Distribution of Weights

Lightship	3670	Long tons
Crew, passengers & stores	60	
Fuel oil, I.B. #1 Cl	132	
#2 P & S	313	
#3 P & S	232	
#5 P & S	232	
#6	108	
#3 deeps	197	
Settling tanks	83	
Fresh water		
Potable water tank	46	
Reserve feed tank	132	
Forepeak	115	
Aft peak	155	
Lazarette	99	
Salt water ballast		
#1 deep tanks P & S	228	
#2 deep tanks P & S	420	
Hold #4	400	
Hold #5	330	
Cargo Hold #1 Empty drums	81	
#3 Empty & full drums	442	
#4 Empty drums	47	
#5 Empty drums	50	
Displacement	7572	Long tons
Corresponding Keel Drafts	12.15' Fwd. 20.17' Aft	

On the basis of the loading shown to the left, indicating the condition at the time of departure from Dutch Harbor, bending moment calculations were made. The uniform calculated stress in the crown of the upper deck when on a standard wave with crest amidships is 15,600 lbs./in.^{2}

S.S. John P. Gaines

REPORT OF STRUCTURAL FAILURE OF INSPECTED VESSEL
UNITED STATES COAST GUARD
CG-2782

This report includes all available information up to: 1 April, 1944 (Date)

DESCRIPTION OF VESSEL

NAME	OFFICIAL NO.	TYPE	M.C. DESIGN
VALERY CHKALOV	None	Dry Cargo Vessel	EC2-S-C1
BUILDER: Permanente Metals Corporation Richmond Shipyard #2		BUILDER'S HULL NO.: #481	DATE COMPLETED: 17 Apr. 43
OWNER: War Shipping Administration		OPERATOR: Union of Soviet Socialist Republics	

EXTENT OF WELDING

Yes SIDE SHELL SEAMS			Yes DECK SEAMS
Yes SIDE SHELL BUTTS	Yes BOTTOM SEAMS	Yes INNER BOTTOM SEAMS	Yes DECK BUTTS
No FRAMES TO SIDE SHELL	Yes BOTTOM BUTTS	Yes INNER BOTTOM BUTTS	Yes BEAMS TO DECK
Yes BULKHEADS	Yes FLOORS TO SHELL	Yes FLOORS TO INNER BOTTOM	Yes DECK TO SHELL

CIRCUMSTANCES SURROUNDING FAILURE

(Attach all available details of ship's loading)

DATE OF FAILURE	TIME	SHIP'S LOCATION	
11 Dec., 1943	1210	Latitude 35° N, Longitude 168°-25' W	
SHIP'S SPEED: Cut by storm	COURSE: Sovetskaya Cavan Siberia to Akutan Alaska	DRAFT FWD.: Not known	DRAFT AFT: Not known
SEA CONDITION: Heavy	WEATHER: Heavy storm, vis. 0	DIRECTION OF WAVES WITH RESPECT TO SHIP: Apparently a head sea	
WIND FORCE: 6 to 8	WIND DIRECTION: Not known	AIR TEMPERATURE: 29° - 34°	WATER TEMPERATURE: Not known

DESCRIPTION OF FAILURE

(Include sketch of fracture showing starting point and relative location of welds and other structural features)

APPARENT STARTING POINT: The cracks which finally broke the vessel started exactly in the forward corners of #3 hatch port and starboard.

GENERAL HISTORY AND DESCRIPTION OF FAILURE, INCLUDING KNOWN CONTRIBUTORY FACTORS:

The vessel departed from Sovetskaya on 1 Dec., 1943, in ballast. Gales and heavy seas were encountered after departure. At noon on 11 Dec., 43, a loud report was heard and three cracks were found, one on the port side at Fr. #74, one on stbd. side at Fr. #74; and one on the stbd. side at Fr. #76. The port side crack extended from the hatch corner across the deck and down the shell to the bilge. The stbd. crack at Fr. #74 was in the side shell from the sheer strake to the tween deck. The stbd. crack at Fr. #76 ran down the side shell from the sheer strake halfway down the tween decks. The vessel was taken in tow by the tug "Joseph Stalin" but at 2206 on 13 Dec. she broke completely in two. Both portions were taken in tow by U. S. Navy tugs and brought to anchorage. The crews did not abandon ship. Ballasting details will be made available by the USSR in the near future.

CLASSIFICATION OF FAILURE: Broke in two

DISPOSITION OF VESSEL

Repaired, Lost, etc.

Both portions at anchor in Sand Bay, Great Sitkin Island. Future undet.

SIGNED *(Name and Title)*

S. S. *Valery Chkalov*

REPORT OF STRUCTURAL FAILURE OF INSPECTED VESSEL
UNITED STATES COAST GUARD
#AVCG-2762

This report includes all available information up to: 1 April, 1944 (Date)

DESCRIPTION OF VESSEL

NAME	OFFICIAL NO.	TYPE	M.C. DESIGN
SAMUEL DEXTER (2)	243200	Dry Cargo Vessel	EC-2-S-C1
BUILDER		BUILDER'S HULL NO.	DATE COMPLETED
Delta Shipbuilding Co., Inc.		# 42	15 Apr. 43
OWNER		OPERATOR	
War Shipping Administration		Waterman Steamship Agency, Ltd.	

EXTENT OF WELDING

Yes SIDE SHELL SEAMS	Hull all welded		Yes DECK SEAMS
Yes SIDE SHELL BUTTS	Yes BOTTOM SEAMS	Yes INNER BOTTOM SEAMS	Yes DECK BUTTS
Yes FRAMES TO SIDE SHELL	Yes BOTTOM BUTTS	Yes INNER BOTTOM BUTTS	Yes BEAMS TO DECK
Yes BULKHEADS	Yes FLOORS TO SHELL	Yes FLOORS TO INNER BOTTOM	Yes DECK TO SHELL

CIRCUMSTANCES SURROUNDING FAILURE

(Attach all available details of ship's loading)

DATE OF FAILURE	TIME	SHIP'S LOCATION	
21 Jan., 1944	2100	Lat. 54°-48' N; Long. 22°-45' W	
SHIP'S SPEED	COURSE	DRAFT FWD.	DRAFT AFT
Hove to 47 RPM	United Kingdom to New York	9'-8"	21'
SEA CONDITION	WEATHER	DIRECTION OF WAVES WITH RESPECT TO SHIP	
High seas	Bad weather	3 points on stbd. bow	
WIND FORCE	WIND DIRECTION	AIR TEMPERATURE	WATER TEMPERATURE
8	WSW	40°	48°

DESCRIPTION OF FAILURE

(Include sketch of fracture showing starting point and relative location of welds and other structural features)

APPARENT STARTING POINT: Forward corners of #3 and #4 hatches port and starboard, all four cracks starting exactly in corner. Aft port corner #3 hatch 3 cracks. Starting point uncertain.

GENERAL HISTORY AND DESCRIPTION OF FAILURE, INCLUDING KNOWN CONTRIBUTORY FACTORS:

At 2100 on 21 Jan., deck cracked opposite #3 hatch and vessel was turned with stern to sea. At 2116 deck cracked at #4 hatch. A thorough examination was made on 22 Jan. and the two cracks from the Ford. corners of #3 hatch were found to extend across the deck and down the side to below the 2nd deck port and starboard. The crack across the deck from the stbd. fwd. corner of #4 ran down the side below the waterline. The top of #3 deep tank in #4 hold was partially cracked. The crack from the port fwd. corner of #4 ran across the deck a distance of 2'. The weather moderated during the 22 to 24 January but a watch was kept on the cracks which were gradually increasing and opened and closed 1" in the seaway. Bad weather was forecast so between 1530 and 1630 on 24 January, the vessel was abandoned.

CLASSIFICATION OF FAILURE: Cracked deck.

DISPOSITION OF VESSEL

Repaired, lost, etc.

Vessel drifted ashore on Barra Island of the Hebrides. Future undet.

SIGNED *(Name and Title)*

See reverse side for loading details.

LOADING AT TIME OF FAILURE

Distribution of Weights

Lightship		3670 Long tons
Crew, passengers & stores		30
Fuel oil, settling tanks		100
Deep tank #3		613
Fresh water, potable water tank		45
Reserve feed		132
Forepeak		141
Aftpeak		155
Salt water ballast		
Deep tank #2		420
Inner bottom	#1	144
	#2	559
	#3	252
	#5	252
	#6	118
Ballast in holds	#2	250
	#3	250
	#4	500
	#5	500
Displacement		7911 Long tons
Corresponding Keel Drafts		10.51 Ford.
		23.05 Aft

On the basis of the loading shown to the left, bending moment calculations were made. The uniform calculated stress in the crown of the upper deck when on a standard wave with crest amidships is 16,700 lbs./in.^{2}

Current Welding Literature

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(*Continued on page 854*)

Welding Aluminum and Its Alloys*

ALUMINUM has certain characteristics that require welding techniques, design, preparation and finishing that are quite different from those for welding steel. It is these differences that present the main difficulty to the beginner, but proficiency in the oxy-acetylene welding of aluminum will come to him after sufficient practice.

Welding Properties of Aluminum

Aluminum has three properties that may be troublesome to the student. First, it does not give warning that it is approaching the welding temperature by a distinguishable change in color, but collapses suddenly upon reaching the melting point. Second, it is hot-short or weak when hot; therefore all areas that will be heated appreciably, either by the actual flame or by the rapid conductivity of the metal, should be supported during welding. Third, the oxide coating from which aluminum derives its corrosion resistance must be removed in order to make a sound weld. This oxide has a higher melting point than the base metal, but it will combine with a suitable flux and form a fusible slag that floats on the puddle during the welding action and can be readily removed.

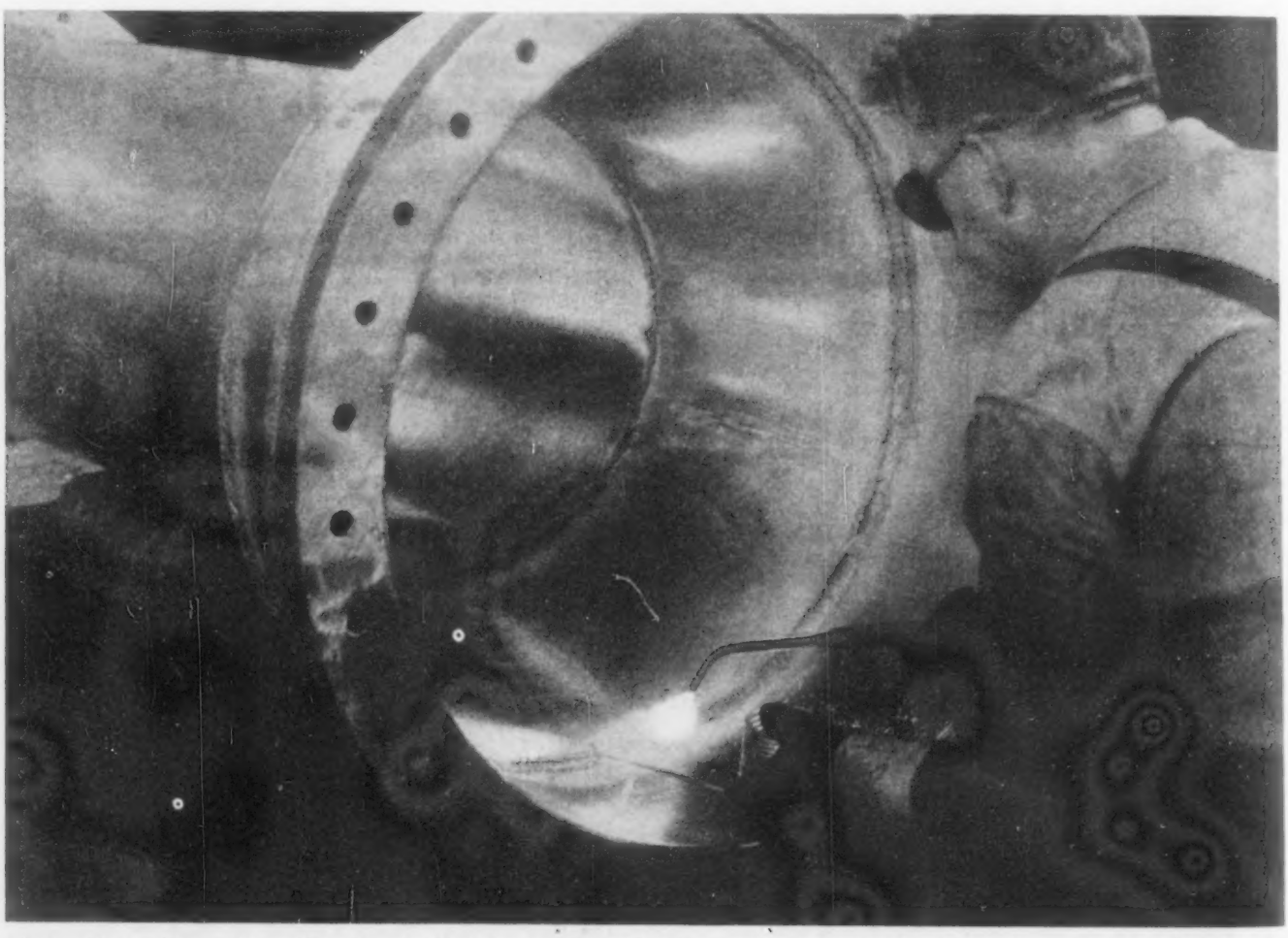
* This article is a digest of a portion of the new Oxy-Acetylene Handbook published by The Linde Air Products Co.

Joint Design for Aluminum Welds

Butt-type joints are satisfactory for welding aluminum sheet that is 16-gage or thinner. This type of joint design requires only that the edges be straight and square.

Flange-type joints are preferable for welding aluminum sheet which is 16-gage or thinner. The flange should be about the same height as the thickness of the sheet or slightly higher. The flange can be turned up by means of a bending brake or it may be prepared by hammering the edge over a steel block while the sheet is clamped, using a wooden mallet.

Notched butt-type joints are used for sheet aluminum from 15- to 5-gage in thickness. The edges of the sheet are notched through their entire thickness about $^1/_{16}$ in



These Three Properties, Peculiar to Aluminum, Must Be Remembered by the Welding Operator: (1) Aluminum Does Not Change Color When Heated. (2) It Has Little Strength Just Before Melting. (3) Aluminum Oxide Has a Higher Melting Point Than Aluminum

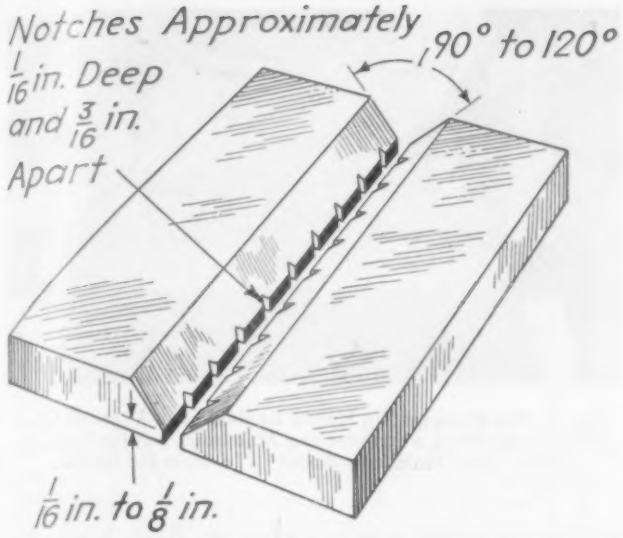


Fig. 1—For Welding Aluminum Plate Up to 7/16 In. Thick, Single-Vee, Notched Butt-Type Joint Preparation Is Used. Notches Should Be Made in the Straight Nose About 1/16 In. Deep and 3/16 In. Apart

deep and about 3/16 in. apart. The notches, such as those sketched in Fig. 1, can be easily made with a hammer and cold chisel. Notched edges aid in obtaining full penetration and the flux has a better chance of working down to the full thickness of the material. In addition, there is less chance of melting holes through the sheet and the notches act as small expansion joints to prevent local distortion.

Lap-type joints are not recommended for aluminum unless no other type of joint can be used. A single lap should never be used as it is practically impossible to remove the flux and oxide particles that have been left along the enclosed side of the weld in this type of joint. If it should be necessary to make a lap-type joint, a double lap weld can be used. Both overlapping edges should be welded completely to the adjacent metal and the ends of the joint should be sealed by welding so that no moisture can get in between the overlapped pieces. Thus the area that cannot be thoroughly cleaned of oxide and flux is sealed off from the air.

Single-vee, notched butt-type joints (see Fig. 1) are used for welding aluminum plate between 3/16 in. and 7/16 in. thick. The plate edges should be beveled to form a vee having an included angle of 90°. A square shoulder of about 1/16 in. to 1/8 in. should be left at the base of the vee. This shoulder should be notched before welding in the same way as was done for the aluminum sheet.

Double-vee, notched butt-type joints should be used for material that is thicker than 7/16 in. whenever welding can be done from both sides. The included angle for each bevel should be 90°, and an unbeveled shoulder of from 1/16 in. to 1/8 in. should be left in the center of each edge. These unbeveled shoulders should then be notched.

Modified single-vee type joints are often useful for material 7/16 in. thick and heavier. The edges should be beveled to form an included angle of 90°. Notching is not used and the straight shoulder can be a little thicker than for single-vee, notched butt-type joints. After the weld has been completed in the vee, the underside of the weld is chipped out to about 10 or 15% of the plate thickness, and this groove is then welded.

Preparation for Welding

Before welding starts, any grease, oil or dirt must be removed from the surfaces to be welded. Also, the oxide with which aluminum becomes coated must be removed to insure a good weld. It is easy to clean the edges thoroughly by scrubbing them with a stiff wire brush and hot water or, if any oil or grease is present, with gasoline.

It is good practice to preheat sheet aluminum along the entire area of the weld with the blowpipe flame in order to decrease the effect of expansion. For plate 3/8 in. or more in thickness, preheating to 500 to 700° F. will aid in avoiding heat stresses and in reducing the amount of gases needed for the actual welding. If the metal for some distance on each side of the joint is kept at a temperature just slightly below its melting point, the additional expansion caused by the welding heat will be small and unlikely to cause distortion. Preheating can be done with a second oxyacetylene blowpipe or by city gas or kerosene torch

The preheating temperature must be kept below 700° F. since higher temperatures will weaken aluminum alloys and may cause large aluminum parts to collapse under their own weight. The beginner should preheat large or complicated parts in a preheating furnace, but as experience is gained the operator will find that local preheating by means of the blowpipe will be sufficient for most work.

The Aluminum Company of America suggests four methods for determining the proper preheating temperature for shops not equipped with pyrometers.

1. At the proper temperature for welding, a pine stick rubbed on a casting will leave a char mark.
2. Chalk marks, made with carpenter's blue chalk, will turn white at the proper temperature for welding.
3. When struck, cold aluminum gives a metallic sound which becomes duller as the temperature is raised. At the temperature required for welding, there is no longer a metallic ring.
4. Special alloys, known as Tempils or Tempil Sticks, that melt sharply at a given temperature can be used to determine preheat temperature.

It is preferable to do practically all aluminum welding in jigs that will support the parts adequately.

Use of Flux

The use of a specially prepared flux is necessary to remove the aluminum oxide which forms rapidly on the

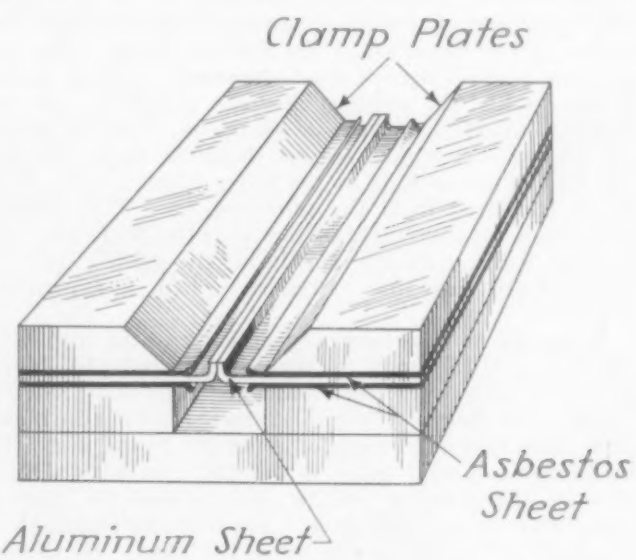


Fig. 2—Because Aluminum Is Weak When Hot, and Because Buckling and Distortion May Occur During Welding, Sheet Aluminum Should Be Welded in Suitable Jigs Between Sheets of Asbestos

molten weld metal and is recommended for all aluminum welding.

Aluminum flux is prepared by mixing the powder with an equal volume of water to form a thin paste of free-flowing consistency. This paste can be applied to the welding rod with a brush or by dipping the rod into a long, slender tube containing the mixture. Steel cannot be used as a container because it contaminates the flux mixture, but a tube of aluminum, brass, glass or a porcelain dish is satisfactory. The mixture should be stirred frequently.

Where no welding rod is used, such as in flange-type joints, the flux is painted on the flanged edges. For welding heavier material, the flux is applied to both the welding rod and the base metal. By painting the seam on both sides, an ample quantity of flux will be assured.

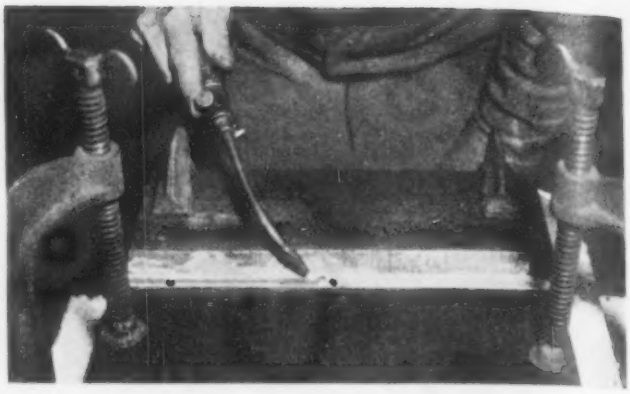


Fig. 3—The Blowpipe Tip Should Be Held at an Angle of About 30° with the Work when Welding Aluminum, and the Tip of the Inner Cone Should Be About 1/8 In. from the Surface

Cleaning and Finishing

When the finished work has cooled sufficiently, no time should be lost in thoroughly treating it to remove all traces of adhering flux. A steam jet is effective for certain classes of work, or the parts may be washed in boiling water. A method that is effective on even the most stubborn cases is to soak the work for 3 min. in hot water, during which time the welds are thoroughly scrubbed with a brush to remove all visible traces of flux. This is followed by washing for 30 min. in a hot 2% nitric acid solution or a cold 10% sulphuric acid solution. The parts are thoroughly brushed and rinsed after the acid bath. For inaccessible welds that cannot be brushed, cleaning can be done by immersing the part in a 5% sulphuric acid solution at 150° F. for 10 min. followed by a clean water rinse.

In finishing welded aluminum products, the welds can be made almost invisible, if desired, by grinding off excess metal or by hammering the seam. Grinding is usually done when products are to be subsequently polished. Hammering should not be done on heat-treated alloys or cast metals.

Control of the Puddle

Before attempting to weld aluminum for the first time, the operator should become thoroughly familiar with the action of the metal under the welding flame. For this purpose, a small piece of sheet aluminum is placed on the welding table, the welding blowpipe is lighted, and the flame adjusted to an excess of acetylene. For the beginner the excess-acetylene feather should be about one and one-half times as long as the inner cone ($1^1/_2\times$), both being measured from the blowpipe tip. This adjustment makes it absolutely certain that the flame does not become oxidizing at any time during the welding, but the excess of acetylene may be reduced a little as experience is gained.

When the flame is held perpendicular to the surface of the sheet and the tip of the inner cone is brought almost in contact with it, the metal suddenly melts away, leaving a hole in the sheet. When this is repeated with the blowpipe flame held at an angle of about 30° to the work, the metal will not melt away so quickly, and with a little practice the operator will be able to melt the surface metal without forming a hole. The operator should then practice moving the puddle across the sheet. He should purposely try moving the puddle too slowly so that he will learn to recognize the signs that mean that it is just about to melt through the sheet. He should move it too rapidly to see the effect of this, and he should notice how quickly the puddle solidifies when the flame is removed. The blowpipe flame for this exercise should be adjusted so as to have a low-velocity gas flow that will produce a soft flame. A harsh or blowy flame will make the puddle much more difficult to control.

When the operator has learned to control the molten puddle, he can proceed to the practice exercise on welding sheet aluminum.

Welding Sheet Aluminum

The materials needed in this practice exercise are a light welding blowpipe with a head of the same size as is used for the same thickness of steel; several pieces of 16-gage commercially pure, wrought aluminum about 3 in. by 6 in.; aluminum flux, water, small porcelain dish, and small paintbrush; and suitable material with which to jig the joints as shown in Fig. 2.

Prepare two pieces of sheet for welding by bending over one long edge of each piece to form a flange of a height about equal to the thickness of the sheet. Clean the edges to be welded by scrubbing them with a stiff wire brush and hot water. Paint both sides of each sheet with the prepared flux mixture along the edges to be welded. Clamp the two pieces in the jig as shown in Fig. 2 and then repaint the weld area with flux.

With the acetylene pressure at 5 lb. per sq. in. and the oxygen pressure at 12 lb. per sq. in., adjust the blowpipe flame to a $1^1/_2\times$ excess of acetylene. Hold the blowpipe at an angle of about 30° to the work with the tip of the inner cone about 1/8 in. away from the metal. Starting at the right end of the joint, melt a small puddle of metal and carry it along the flanged edges. Try to get thorough penetration of the welding action to the underside of the sheet and leave a smooth, even, ripple effect on the top. The additional metal furnished by the flanges should result in a built-up surface with ample reinforcement.

As soon as the weld has cooled, remove the sheets from the jig, scrub off all extra flux with hot water and a stiff brush, and examine the weld. There should be thorough penetration to the underside without excessive globules of metal protruding. When the operator has become proficient in making flange-type welds in sheet aluminum, he is ready for the practice exercise on aluminum plate.

Welding Aluminum Plate

In addition to the materials required for the exercise on welding sheet aluminum, the operator will need for this

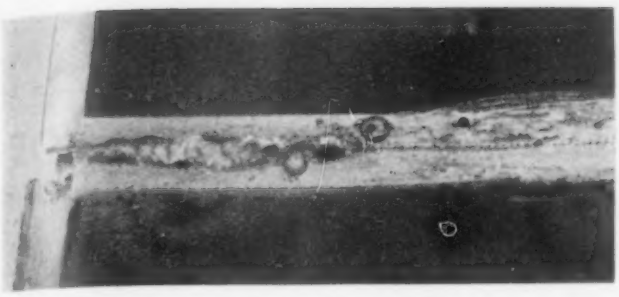


Fig. 4—A "Forced" or Too Hot Flame Was Used in This Attempt to Weld Aluminum, Resulting in Holes in the Base Metal and Lack of Penetration. Complete Lack of Control Is Illustrated

practice exercise a welding head of the size used for welding $^3/_{16}$-in. steel, several pieces of $^3/_{16}$-in., commercially pure, wrought aluminum about 3 in. by 6 in., and some $^1/_8$-in. diameter aluminum welding rod of good quality. No jig is needed in this exercise.

Prepare the edges of the aluminum plates for welding in accordance with the instructions given for the single-vee, notched butt-type joints. Clean the edges and paint with flux the same as in the last exercise and also paint the welding rod with flux.

With the acetylene pressure at 5 lb. per sq. in. and the oxygen pressure at 15 lb. per sq. in., again adjust the blowpipe to a $1^1/_2 \times$ excess of acetylene. Tack weld the two pieces of plate so that there is a spacing of about $^1/_8$ in. at the right end and $^3/_8$ in. at the left. On long seams the spacing should be uniform for the entire length and tack welds spaced about every 3 or 4 in., when Oxweld No. 14 aluminum welding rod is used.

Hold the blowpipe at an angle of about 30° to the work and start welding about $1^1/_2$ in. from the right end of the vee, proceeding from right to left. The welding technique is practically the same as that used for a similar thickness of steel. Swing the blowpipe and welding rod through small opposing arcs across the vee during the welding operation so that the flame may play first upon one side of the vee and then upon the other, and thus prepare the plate edges for fusion with the puddle. The end of the welding rod should be kept in the puddle and should be used to stir the puddle vigorously during welding to work all oxides to the surface. If the slag floating on the puddle becomes too large and gets in your way, it can be lifted out with the welding rod and then shaken or knocked off. After the left end of the vee has been reached, turn the plates around and complete the joint, beginning at the point where welding started.

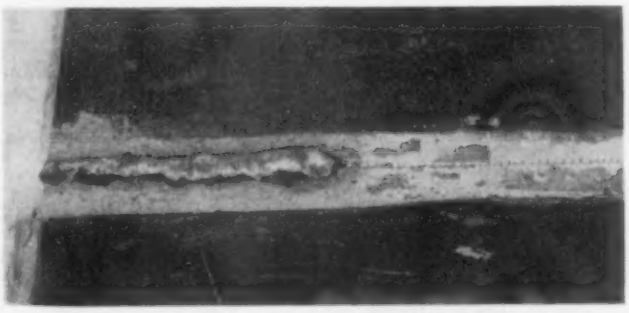


Fig. 5—This Picture Illustrates the Result of a Flame Adjustment That Is Even Slightly Oxidizing. The High-Melting-Point Oxides Cause the Metal to Form Into Balls, Resulting in Poor Penetration

Heavy Plates and Castings

When heavy aluminum plate is welded, it will be advantageous to deposit the weld metal as a series of layers rather than to fill the vee all in one pass. The flame should be directed slightly more upon the base metal than upon the rod, care being taken, however, not to melt the base metal excessively. In this way, the contour of the deposited layers will be made concave rather than convex. If the top surface of any of the layers except the last is allowed to become convex, considerable difficulty will be found in obtaining thorough fusion with the next layer. This multilayer method, however, should be used only in connection with a commercially pure, drawn aluminum rod. When a high-strength rod is used for welding the stronger aluminum alloys and castings, the weld should be completed in one pass whenever possible and no tack welds should be used. The same is true for

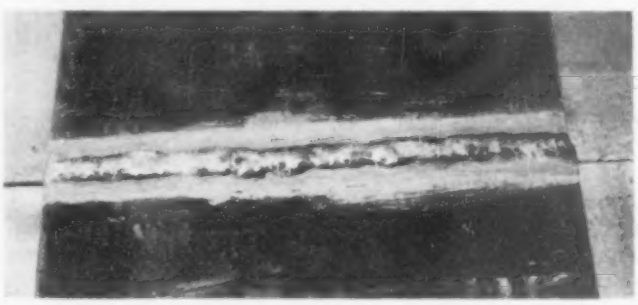


Fig. 6—When the Operator Directs Too Much Heat on the Rod and Not Enough on the Base Metal, the Proper Fusion Between the Added Metal and the Base Metal Is Not Obtained

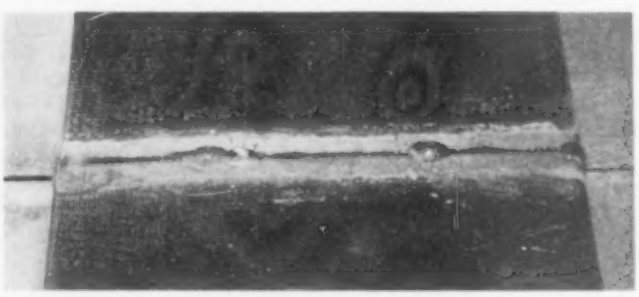


Fig. 7—When the Operator Welds Too Rapidly, the Weld Will Have a Fairly Good Appearance from the Top, but There Will Be a Lack of Penetration, Visible from the Underside

heat-treated alloys. If it is at all possible, parts made of the heat-treated aluminum alloys should be heat treated after welding. The advice of the manufacturer of the aluminum base metal should be sought on this since he is most familiar with the heat treatment which was used in manufacturing these alloys. In general, the parts to be heat treated should be placed in a suitable furnace and heated to a temperature of from 890 to 970° F., depending on the alloy, and then quenched in cold water.

Preheating is necessary in welding aluminum castings, and fractured areas should be veed for welding. The same basic technique as that used for aluminum plate is successful on many types of castings, but some alloys are not so easily welded, particularly when the analysis of the casting is not known. A short section of steel rod, flattened on one end to form a paddle, can be used to work oxides or impurities out of the puddle. After the welding is completed, the casting, whether in a preheating furnace or not, should be protected from drafts and allowed to cool slowly. It should remain covered until completely cold, after which it can be finished by grinding or filing.

Proposed Recommended Practices for Resistance Welding

3. Recommended Practice for the Flash-Butt Welding of Low & Medium Forging Strength Steels

THIS is the third in the series of recommended practices for resistance welding being prepared by the AMERICAN WELDING SOCIETY Resistance Welding Committee.* This standard has not yet been approved and is published here for the purpose of eliciting comments and suggestions. To be considered, correspondence regarding this standard should be addressed to Secretary, Resistance Welding Committee, AMERICAN WELDING SOCIETY, 33 West 39th St., New York 18, N. Y. so that they arrive not later than Oct. 16, 1944.

1.0 The data presented herewith represent a compilation of information received from members of the Subcommittee on Flash Welding, Resistance Welding Committee, AMERICAN WELDING SOCIETY, and have been circulated among numerous fabricators before being drafted in their present form.

2.0 It should be realized that these data should produce welds of the highest quality. No inference is intended that variations cannot be made from these data, but the exact degree of variation which may be made and still produce welds of optimum quality is not known.

In correlating the material for these standards, it was realized that it would be necessary first to define the process variables as well as to specify the method of measurement of some of these variables. Such definitions with accompanying definition chart are given below.

When applying these standards and considering the definitions, it should be realized that not all flash-butt welding equipment nor all such welding schedules simultaneously make use of all the listed variables.

The most commonly met applications use no preheating, dual flashing currents or postheating, but consist of flashing at a single current, followed by upsetting. Most equipment now in production performs only the two above functions.

3.0 DEFINITIONS

(See Flash-Butt Welding Definitions Chart, Fig. 1.)

3.1 —*Weld Line* is the plane of fusion of the welded parts.

3.2 —*Flash* is the extraneous material which is thrown and extruded from the weld line during the flashing and upsetting actions.

3.3 —*Initial Die Opening* (A, in.) is the distance between the dies when the work pieces first contact.

3.4 —*Material Lost* (B, in.) is the total length of material that is used in making the weld.

3.5 —*Final Die Opening* (C, in.) is the distance between the dies at the completion of the weld.

3.6 —*Total Flash-off* (D, in.) is the total length of material that is lost in flashing.

3.7 —*Manual Flash-Off* (E, in.) is the length of material that is lost in flashing while the flashing is controlled manually.

3.8 —*Automatic Flash-Off* (F, in.) is the length of material that is lost in flashing while the flashing is controlled automatically.

3.9 —*Preheating Loss* (G, in.) is the length of material that is lost as the result of the preheating action.

3.10—*Total Upset* (H, in.) is the length of material that is lost as the result of the forging action.

3.11—*Material X Lost* (J, in.) is the length of Material X that is used in making the weld.

3.12—*Material Y Lost* (K, in.) is the length of Material Y that is used in making the weld.

3.13—*Initial Extension, Material X* (L, in.) is the dimension from the die which clamps Material X to that point on Material X which first contacts Material Y.

3.14—*Initial Extension Material Y* (M, in.) is the dimension from the die which clamps Material Y to that point on Material Y which first contacts Material X.

3.15—*Final Extension, Material X* (N, in.) is the dimension from the die which clamps Material X to the Weld Line at the completion of the weld.

3.16—*Final Extension, Material Y* (P, in.) is the dimension from the die which clamps Material Y to the Weld Line at the completion of the weld.

3.17—*Travel at* I_1 (Q, in.) is the dimension the movable platen (Material Y) travels during the flashing current, I_1.

3.18—*Travel at* I_2 (R, in.) is the dimension the movable platen (Material Y) travels during the flashing current, I_2.

3.19—*Spring-back* (in.) is the deflection of the welding machine when making the weld.

3.20—*Preheating Time* (sec.) is the time that elapses while preheating is taking place.

3.21—*Manual Flash-Off Time* (sec.) is the time that elapses while flashing by manual control is taking place.

3.22—*Automatic Flash-Off Time* (sec.) is the time that elapses while flashing by automatic control is taking place.

3.23—*Time at Flashing Current* I_1 (sec.) is the time that elapses while flashing with current I_1.

3.24—*Time at Flashing Current* I_2 (sec.) is the time that elapses while flashing with current I_2.

* See August 1944 WELDING JOURNAL for Spot and Seam Welding Recommended Practices.

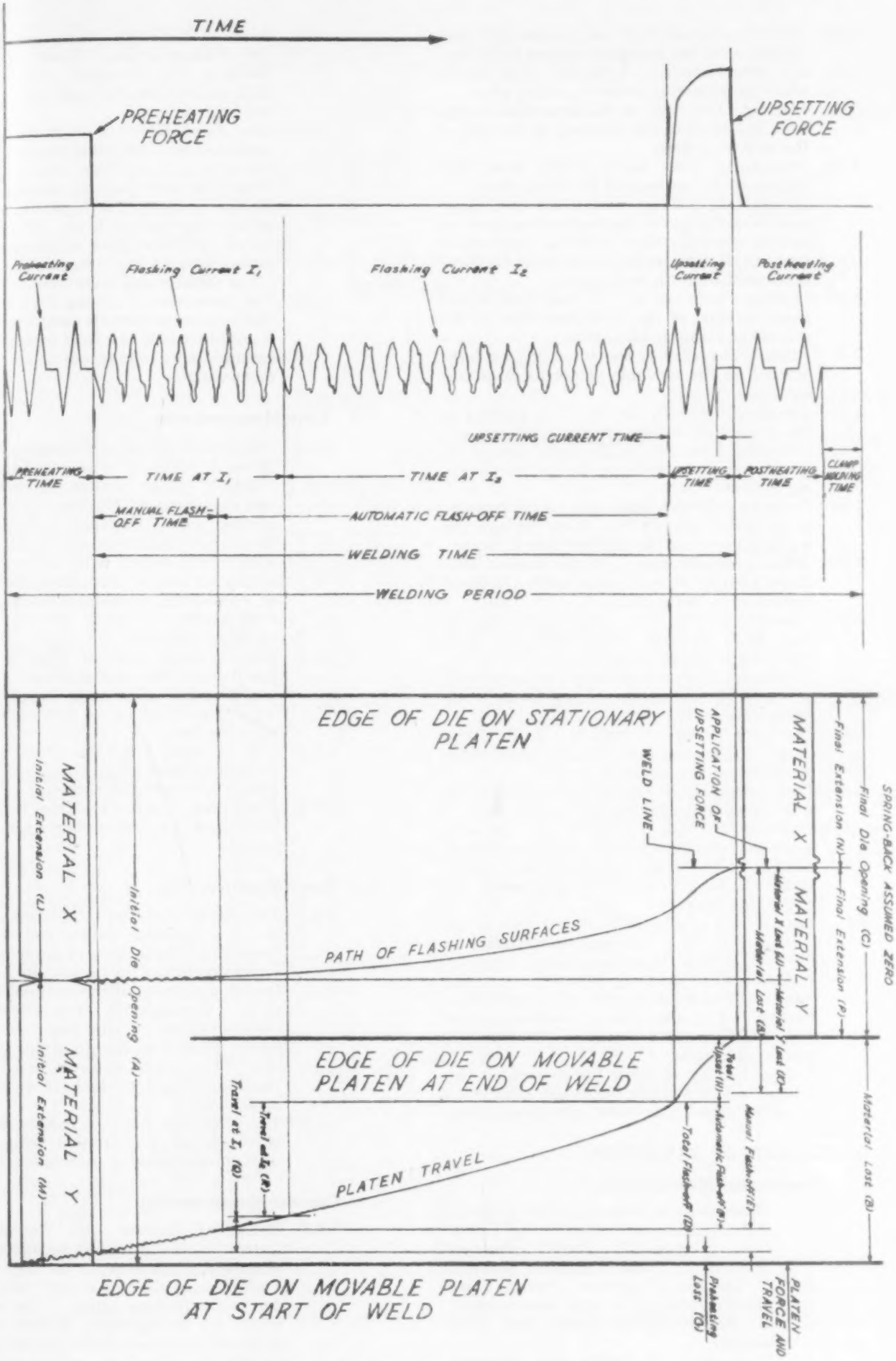


Fig. 1—Flash-Butt Welding Definition Chart

3.25—*Upsetting Current Time* (sec.) is the time that elapses while the upsetting current is flowing.

3.26—*Upsetting Time* (sec.) is the time that elapses while the upsetting action is taking place.

3.27—*Welding Time* (sec.) is the time that elapses from the start of the flashing to the end of the upsetting time.

3.28—*Postheating Time* (sec.) is the time that elapses while postheating is taking place.

3.29—*Clamp-Holding Time* (sec.) is the time measured from the end of the postheating time (or end of upsetting time when no postheat is used) to the time at which the clamping force is released from the workpieces.

3.30—*Welding Period* (sec.) is the time that elapses from the start of the preheating time to the end of the clamp-holding time.

3.31—*Platen Force* (lb.) is the total driving force exerted on the movable platen to cause upsetting.

3.32—*Upsetting Force* (lb.) is the force exerted at the contacting surfaces during upsetting.

3.33—*Clamping Force* (lb.) is the force exerted on the clamping electrodes or dies by the clamping system.

3.34—*Preheating Current* (rms. amp.) is the periodic or aperiodic current that flows through the workpieces before the flashing action starts.

3.35—*Flashing current* (amp.) is the current that flows through the workpieces while the flashing action is taking place.

3.36—*Upsetting Current* (rms. amp.) is the current that flows through the workpieces while upsetting is taking place.

3.37—*Postheating Current* (rms. amp.) is the periodic or aperiodic current that flows through the workpieces during the postheating time.

3.38—*Secondary Voltage, E* (rms. v.) is the open-circuit voltage of the welding transformer measured on the secondary side.

3.39—*Load Voltage, V* (v.) is the voltage across the workpieces while welding and postheating.

3.40—*Instantaneous Rate of Flash-Off* (in. per sec.) is the instantaneous velocity of one workpiece relative to the other during flashing action and is the first derivative of such motion at a specified position.

3.41—*Average Rate of Flash-Off* (in. per sec.) is the average velocity of one workpiece relative to the other during the entire flashing action.

3.42—*Instantaneous Velocity of Upset* (in. per sec.) is the instantaneous velocity of one workpiece relative to the other during upsetting action and is the first derivative of such motion at a specified position.

3.43—*Average Velocity of Upset* (in. per sec.) is the average velocity of one workpiece relative to the other during the entire upsetting action.

4.0 DISCUSSION OF VARIABLES

4.1 Dimensional Measurements:

4.1.1—Dimensions of *Material Lost; Material X Lost; Material Y Lost; Initial Extension, Material X; Initial Extension Material Y; Final Extension, Material X;* and *Final Extension, Material Y* are usually obtained by scale measurement of the workpieces before and after welding.

4.1.2—Dimensions of *Initial Die Opening; Final Die Opening; Total Flash-Off Manual Flash-Off; Automatic Flash-Off; Preheating Loss; Travel at* I_1; *and Travel at* I_2 are usually obtained by scale measurement of such items on the welding machine.

4.1.3—The *Total Upset* is most accurately measured by subtracting the sum of the measurements of *Total Flash-Off* and *Preheating Loss* from the measurement of *Material Lost*. The high speed of upsetting together with the error introduced by *Spring-back* of the machine makes it difficult to measure the *Total Upset* directly and accurately.

4.1.4—The dimension of *Spring-Back* is difficult to measure directly and fortunately is not important as a weld variable. It assumes more importance as an equipment variable.

4.2 Time Measurements

4.2.1—The time intervals of *Preheating Time; Manual Flash-Off Time; Automatic Flash-Off Time; Time at Flashing Current* I_1; *Time at Flashing Current* I_2; *Welding Time; Postheating Time;* and *Welding Period* can usually be measured with a stop-watch with sufficient accuracy, or can be taken from the chart of a recording instrument such as an oscillograph, recording ammeter, recording wattmeter, etc.

4.2.2—The *Upsetting Current Time* can be taken from the records of an oscillograph or recording ammeter, depending on the length of the time and accuracy desired.

4.2.3—The *Upsetting Time* can be most conveniently taken from the record of a Platen Movement Recorder.

4.2.4—The *Clamp-Holding Time* can be taken by the use of a dial or chart-type cycle counter.

4.3 Force Measurements

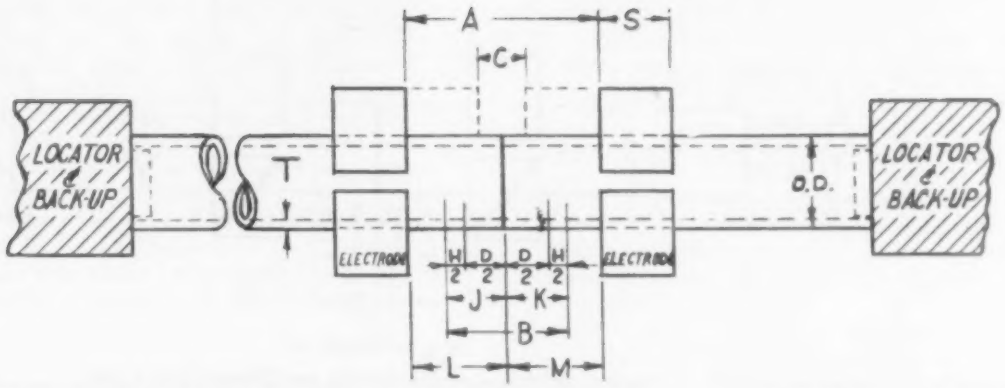
4.3.1—The *Platen Force* and *Upsetting Force* are of a transient nature and are influenced by the method of applying the forces, by friction, by inertia and by the opposing reaction of the material being upset. Consequently, it is difficult to obtain precise measurement of such forces without elaborate strain gages, etc. There are no well-recognized simple approximate methods of measurement in use.

4.3.2—The *Clamping Force* is usually calculated, the effect of friction being considered when making such calculations.

4.4 Current Measurements

4.4.1—*Preheating Current* and *Postheating Current* can be measured by indicating or recording ammeters or oscillographs.

4.4.2—The *Flashing Current* is very irregular due to the flashing action of the weld. While an oscillographic record is an accurate indication of this current, such records are difficult to analyze readily. Records taken with recording ammeters



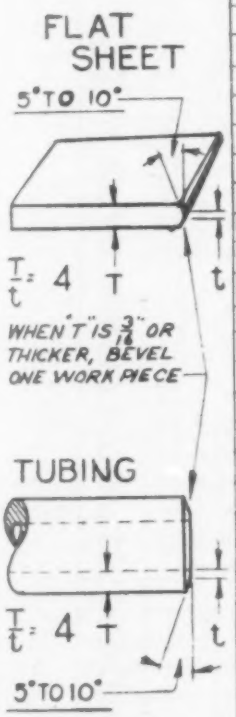
T = Tube Wall or Sheet Thickness
A = Initial Die Opening
B = Material Lost
C = Final Die Opening
D = Total Flash-Off
H = Total Upset
J = K = Material Lost per Piece
L = M = Initial Extension per Piece
O.D. = Outside Dia. of Tubing
S = Minimum Necessary Length of Electrode Contact

NOTE - DATA IS BASED ON WELDING WITHOUT PREHEATING & BOTH PIECES HAVING THE SAME WELDING CHARACTERISTICS.

T Inches	A Inches	B Inches	C Inches	D Inches	H Inches	J = K Inches	L = M Inches	Flashing Time Seconds
.010	.110	.060	.050	.040	.020	.030	.055	.40
.020	.215	.115	.100	.080	.035	.058	.108	.80
.030	.325	.175	.150	.125	.050	.088	.163	1.25
.040	.430	.230	.200	.165	.065	.115	.215	1.75
.050	.530	.280	.250	.205	.075	.140	.265	2.25
.060	.620	.330	.290	.240	.090	.165	.310	2.75
.070	.715	.385	.330	.280	.105	.193	.358	3.50
.080	.805	.435	.370	.315	.120	.218	.403	4.00
.090	.885	.475	.410	.345	.130	.238	.443	4.50
.100	.970	.520	.450	.375	.145	.260	.485	5.00
.110	1.060	.570	.490	.410	.160	.285	.530	5.75
.120	1.140	.610	.530	.440	.170	.305	.570	6.25
.130	1.225	.650	.575	.470	.180	.325	.613	7.00
.140	1.320	.700	.620	.510	.190	.350	.660	7.75
.150	1.390	.730	.660	.530	.200	.365	.695	8.50
.160	1.470	.770	.700	.560	.210	.385	.735	9.00
.170	1.540	.800	.740	.580	.220	.400	.770	9.75
.180	1.620	.840	.780	.610	.230	.420	.810	10.50
.190	1.690	.870	.820	.630	.240	.435	.845	11.25
.200	1.760	.900	.860	.650	.250	.450	.880	12.00
.250	2.010	1.010	1.000	.730	.280	.505	1.005	16
.300	2.245	1.120	1.125	.810	.310	.560	1.123	21
.350	2.460	1.210	1.250	.880	.330	.605	1.230	27
.400	2.640	1.290	1.350	.930	.360	.645	1.320	33
.450	2.780	1.350	1.430	.970	.380	.675	1.390	38
.500	2.910	1.410	1.500	1.020	.390	.705	1.455	45
.550	3.040	1.465	1.575	1.055	.410	.733	1.520	50
.600	3.135	1.505	1.630	1.085	.420	.753	1.568	56
.650	3.245	1.555	1.680	1.125	.430	.778	1.623	63
.700	3.360	1.610	1.750	1.160	.450	.805	1.680	70
.800	3.525	1.675	1.850	1.210	.465	.838	1.763	83
.900	3.660	1.730	1.930	1.250	.480	.865	1.830	97
1.000	3.800	1.800	2.000	1.300	.500	.900	1.900	110

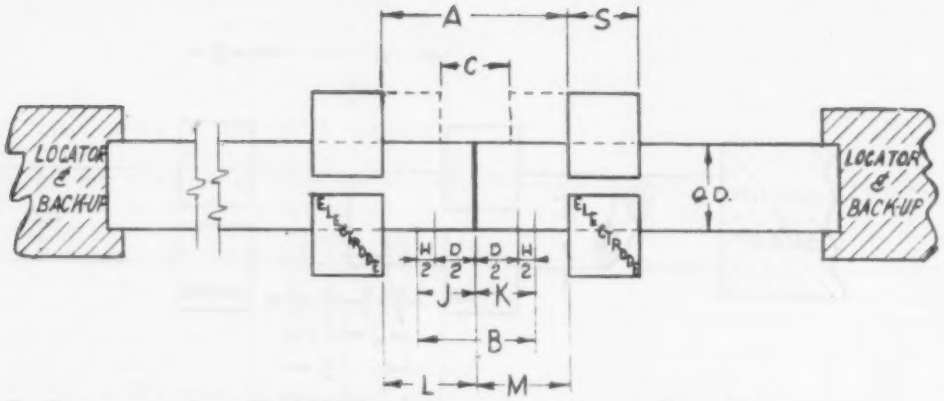
O.D. Inches	S With Locator	S Without Locator
.250	.375	1.00
.312	.375	1.00
.375	.375	1.50
.500	.375	1.75
.750	.500	2.00
1.000	.750	2.50
1.50	1.000	3.00
2.00	1.250	
2.50	1.750	
3.00	2.000	
3.50	2.25	
4.00	2.50	
4.50	2.75	
5.00	2.75	
5.50	3.00	
6.00	3.25	
6.50	3.50	
7.00	3.75	
7.50	4.00	
8.00	4.25	
8.50	4.50	
9.00	4.75	
9.50	5.00	
10.00		

DO NOT RECOMMEND WITHOUT USE OF LOCATOR



RECOMMENDED END PREPARATION

Fig. 2—Flash-Butt Welding of Tubing and Flat Sheets of Low and Medium Forging Strength Steels



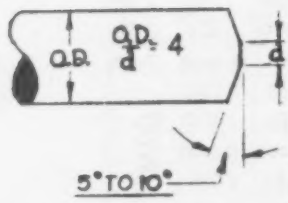
O.D.= Diameter of Rounds or Minimum Dimension of Other Sections
A= Initial Die Opening
B= Material Lost
C= Final Die Opening
D= Total Flash-off
H= Total Upset
J=K= Material Lost per Piece
L=M= Initial Extension per Piece
S= Minimum Necessary Length of Electrode Contact

NOTE: DATA IS BASED ON WELDING WITHOUT PREHEATING & BOTH PIECES HAVING THE SAME WELDING CHARACTERISTICS

O.D. INCHES	A INCHES	B INCHES	C INCHES	D INCHES	H INCHES	J=K INCHES	L=M INCHES	FLASHING TIME-SECONDS
.050	.100	.050	.050	.040	.010	.025	.050	.40
.100	.182	.082	.100	.062	.020	.041	.091	.75
.150	.270	.120	.150	.090	.030	.060	.135	1.15
.200	.350	.150	.200	.110	.040	.075	.175	1.50
.250	.430	.180	.250	.130	.050	.090	.215	1.90
.300	.510	.210	.300	.150	.060	.105	.255	2.25
.350	.600	.250	.350	.180	.070	.125	.300	2.75
.400	.685	.285	.400	.205	.080	.143	.343	3.25
.450	.770	.320	.450	.230	.090	.160	.385	3.75
.500	.850	.350	.500	.250	.100	.175	.425	4.25
.550	.940	.390	.550	.280	.110	.195	.470	5.00
.600	1.025	.425	.600	.305	.120	.213	.513	5.50
.650	1.100	.450	.650	.325	.125	.225	.550	6.75
.700	1.180	.480	.700	.350	.130	.240	.590	7.50
.750	1.260	.510	.750	.375	.135	.255	.630	8.25
.800	1.340	.540	.800	.400	.140	.270	.670	9.00
.850	1.420	.570	.850	.425	.145	.285	.710	9.75
.900	1.500	.600	.900	.450	.150	.300	.750	10.50
.950	1.580	.630	.950	.475	.155	.315	.790	11.75
1.000	1.660	.660	1.000	.500	.160	.330	.830	13.00
1.050	1.740	.690	1.050	.525	.165	.345	.870	14.75
1.100	1.820	.720	1.100	.550	.170	.360	.910	16.50
1.150	1.900	.750	1.150	.575	.175	.375	.950	18.25
1.200	1.980	.780	1.200	.600	.180	.390	.990	20.00
1.250	2.060	.810	1.250	.625	.185	.405	1.030	22.50
1.300	2.140	.840	1.300	.650	.190	.420	1.070	25.00
1.400	2.300	.900	1.400	.700	.200	.450	1.150	30.00
1.500	2.460	.960	1.500	.750	.210	.480	1.230	38.00
1.600	2.620	1.020	1.600	.800	.220	.510	1.310	45.00
1.700	2.780	1.080	1.700	.850	.230	.540	1.390	54.00
1.800	2.940	1.140	1.800	.900	.240	.570	1.470	63.00
1.900	3.100	1.200	1.900	.950	.250	.600	1.550	75.00
2.000	3.260	1.260	2.000	1.000	.260	.630	1.630	90.00

O.D. INCHES	S WITH LOCATOR	S WITHOUT LOCATOR
.250	.375	1.00
.312	.375	1.00
.375	.375	1.50
.500	.375	1.75
.750	.500	2.00
1.000	.750	2.50
1.50	1.000	3.00
2.00	1.25	
2.50	1.75	
3.00	2.00	
3.50	2.25	
4.00	2.50	
4.50	2.75	
5.00	2.75	
5.50	3.00	
6.00	3.25	
6.50	3.50	
7.00	3.75	
7.50	4.00	
8.00	4.25	
8.00	4.50	
9.00	4.75	
9.50	5.00	
10.00		

DO NOT RECOMMEND WITHOUT USE OF BACK-UPS



1/4" O.D. OR LARGER - BEVEL ONE WORK PIECE

RECOMMENDED END PREPARATION

Fig. 3—Flash-Butt Welding of Solid Round, Hex, Square and Rectangular Bars of Low and Medium Forging Strength Steels

NOTE: The above values apply only where the ratio of the maximum to minimum cross-sectional dimension does not exceed 1.5 to 1.0.

are usually sufficiently accurate and permit easier analysis to the extent that such records are in common use. To transfer data from one welding schedule to another by means of recording ammeters, requires that such ammeters have equivalent damping characteristics. Standard methods are being developed for the calibration of the damping characteristics of recording ammeters.

4.4.3—*Upsetting Current* can be precisely measured by an oscillograph or by "pointer-stop" ammeters for a slightly less, but generally satisfactory, degree of accuracy.

4.5 Voltage Measurements

4.5.1—*Secondary Voltage* can be measured using an indicating voltmeter.

4.5.2—The *Load Voltage* is as irregular as the *Flashing Current* and a recording voltmeter can be used to measure this load voltage.

4.6 Rates and Velocities of Flash-Off and Upset

4.6.1—*The Average Rate of Flash-Off* can be calculated from the *Flash-Off Time* and the *Total Flash-Off*.

4.6.2—The *Instantaneous Rate of Flash-Off*, the *Instantaneous Velocity of Upset* and the *Average Velocity of Upset* can be measured by the use of any device which will satisfactorily record mechanical motion and time.

5.0 CLASSIFICATION OF STEELS FOR FLASH-BUTT WELDING

The values of the *Upsetting Forces* required for various sections of various steels are related to the temperature gradient of the workpieces in the plastic zone and to the compressive strengths of the steels at these elevated temperatures.

For consideration of applying the flash-butt welding process to steels, such steels are classified as follows and typical steels of the various classes are given.

5.1—*Low Forging Strength Steels*

This class is typified by S.A.E. 1020, S.A.E. 1112, S.A.E. X-1112, S.A.E. X-1315, Cor-Ten, Man-Ten, Sil-Ten, NAX 9115, Yoloy, Ductiloy, Cromansil, Republic RDS, etc.

5.2—*Medium Forging Strength Steels*

This class is typified by S.A.E. 1045, S.A.E. 1065, S.A.E. X-1335, S.A.E. 3135, S.A.E. 4130, S.A.E. 4140, NE 8442, NE 8640, NE 9440, NE 9540, NE 9640, etc.

5.3—*High Forging Strength Steels*

This class is typified by S.A.E. X-4340, S.A.E. 4640, stainless iron (12% chrome type), stainless steel (18–8 type), stainless steel (cutlery type), high-speed steel, Sil-chrome, special tool, die and austenitic valve stem steels.

5.4—*Extra High Forging Strength Steels*

This class is typified by all steels exhibiting extra high compressive strengths at elevated temperatures such as Timken Alloy, etc.

6.0 FLASH-BUTT WELDING SCHEDULES

6.1—Flash-Butt Welding Schedules for welding tubing and flat sheets having thicknesses ranging from 0.010 to 1.00 in. are given in Fig. 2 and cover steels of Low and Medium Forging Strength.

6.2—Flash-Butt Welding Schedules for welding solid round, hex, square and rectangular bars having an outside diameter of rounds or minimum dimension of other sections ranging from 0.050 to 2.00 in. are given in Fig. 3, and cover steels of Low and Medium Forging Strength.

6.3—The schedules given on these two drawings show the necessary dimensions for setting up a flash-butt welder to weld such sections and the total flashing time based on welding without preheating.

6.4—No data are available as to the necessary Flashing Currents, rates and velocities of Flash-Off and Upset required.

When setting up a schedule, the dimensionable variables and flashing time are selected from the tabulations and the welder voltage regulator adjusted to give the lowest Secondary Voltage, *E*, at which steady and consistent flashing can be obtained. The flashing current resulting from such voltage setting will then be at a satisfactory value.

The Secondary Voltage, *E*, to obtain this satisfactory Flashing Current, is dependent on the electrical characteristics of the welding machine being used.

6.5—The Upsetting Forces used for the schedules are dependent upon the class of steel as well as on the section being welded.

Experience indicates that the selection of equipment should be based on the following values of recommended Platen Force and such values are based on the welding heat being attained solely by flashing, i.e., no preheating:

6.5.1—*Low Forging Strength Steels*—10,000 psi. of weld sectional area.

6.5.2—*Medium Forging Strength Steels*—15,000 psi. of weld sectional area.

6.5.3—*High Forging Strength Steels*—25,000 psi. of weld sectional area.

6.5.4—*Extra High Forging Strength Steels*—35,000 psi. of weld sectional area.

7.0 SURFACE FINISH

Surfaces of parts between the electrodes or contacting the electrodes should be free of dirt, scale, paint, oil or grease, and smooth enough to obtain an adequate area and distribution of contact.

THE AMERICAN WELDING SOCIETY

ACTIVITIES – RELATED EVENTS

300 MANUFACTURERS MAKE RECORD ADVANCE DISPLAY RESERVATIONS FOR METAL CONGRESS

Some 300 manufacturers and organizations serving the metal industry have broken a 26-yr. record for advance reservations of display space in the War Conference Displays and National Metal Congress. Scheduled for the week of October 16 in Cleveland's Public Hall, the Metal Congress is still weeks away but already larger than ever before.

"These heavy advance reservations reflect the cooperative spirit of the metal industry and its desire to come to grips with the problems that lie ahead," said W. H. Eisenman, managing director of the Congress and national secretary of the American Society for Metals.

"Many vital problems have been solved during the last three annual meetings, but the adjustments that confront the industry today can only be met by getting together to take stock of the advances that have been made in these war years.

"It is time," Mr. Eisenman continued, "to knit together the developments that have been made, to survey the present situation of the industry. For example, some sections of the metal industry may be converting at least a part of their production to civilian markets in the near future.

"These companies must get reacquainted with the new executives, engineers and production men that occupy important positions in their field today. And on the other hand, these men must be familiar with what industry has to offer. Nowhere outside the Metal Congress is there a common meeting-place where this huge cross section of the metal industry can get together.

"It is this desire to prepare—to get ready for whatever faces us in the immediate months ahead that brings together these 300 manufacturers where they may meet with the thousands of metal men who have made the Metal Congress their annual postgraduate course in metals."

The Metal Congress is sponsored by the American Society for Metals in cooperation with the AMERICAN WELDING SOCIETY, the Iron and Steel and Institute of Metals divisions of the American Institute of Mining and Metallurgical Engineers, the American Industrial Radium and X-Ray Society and the Society for Experimental Stress Analysis.

Technical sessions will be held each morning, afternoon and evening during the Congress with nearly a thousand metal experts collaborating in the preparation and presentation of some 150 lectures.

WELDABILITY STANDARDS FOR ALTERNATE AIRCRAFT STEELS

The increase in aircraft production has necessitated the use of steels hitherto not used or little used by the aircraft industry. This in turn has created the problem of the weldability of these steels. To meet this problem the American Welding Society has recently published "Weldability Standards for Alternate Aircraft Steels" which sets forth a series of tests enabling the comparison of proposed alternate steels with standard aircraft steels.

The standards are based on a research investigation of the problem covering both arc and gas welding, and the prescribed tests have been selected not only for their reliability but also for their ease of performance in the usual aircraft plant.

Included are the Tee-Bend Test; Transverse Butt-Joint Tension Test of 1/4-In. Plate; Transverse Butt-Joint Tension Test of 1/8-In. Sheet; Transverse Butt-Joint Tension Test of Tubing; and Welded Double-Tube Triangle Test.

Test specifications include test plate dimensions, filler metal sizes, preheating and welding procedures as well as the methods of testing.

Copies of the standard are available in the form of a 6 x 9 bulletin from the AMERICAN WELDING SOCIETY, 33 West 39th Street, New York 18, N. Y., at a price of 25¢ per copy.

1944–45 OFFICERS AMERICAN WELDING SOCIETY

Since no nominations other than proposed by the Nominating Committee have been made by 25 qualified members, as prescribed by the By-Laws, the nomination ballots are treated as election ballots. Accordingly, the following have been elected officers for the year to begin on the adjournment of the 1944 Annual Meeting. These officers will be declared elected at the Business Session of the Annual Meeting.

President, A. C. Weigel, Vice-President, Combustion Engineering Co., Inc., New York, N. Y.

First Vice-President, Isaac Harter, Vice-President, The Babcock & Wilcox Co., Barberton, Ohio.

Second Vice-President, Wendell F. Hess, Assoc. Prof. Metallurgical Engineering, Rensselaer Polytechnic Inst., Troy, N. Y.

Treasurer, O. B. J. Fraser, Dir. Technical Service on Mill Products, International Nickel Co., New York, N. Y.

Directors at Large: R. W. Clark, Welding Engineer, General Electric Co., Schenectady, N. Y.; L. W. Delhi, Manager, Western Pipe & Steel Co., San Francisco, Calif., J. F. Lincoln, President, The Lincoln Electric Co., Cleveland, Ohio; H. M. Priest, Engineer, Railroad Research Bureau, U. S. Steel Corp., Pittsburgh, Pa.

District Vice-Presidents: District No. 1 (New York and New England)—F. C. Fyke, Materials Engineer, Standard Oil Development Co., General Engineering Dept., Elizabeth, N. J. District No. 2 (Mid-Eastern)—H. W. Lawson, Engineer, Bethlehem Steel Co., Bethlehem, Pa. District No. 3 (Southern)—F. E. McAtee, Asst. Supt., Chicago Bridge & Iron Co., Birmingham, Ala. District No. (Central)—J. F. Maine, Chief Engineer, Republic Structural Iron Works Co., Cleveland, Ohio. District No. 5 (Mid-Eastern)—W. J. Brooking, Director Testing & Research Dept., R. G. LeTourneau, Inc., Peoria, Ill. District No. 6 (Mid-Southern)—M. A. Barrett, Shop Engineer, Beech Aircraft Corp., Wichita, Kan. District No. 7 (Western)—F. A. Longo, General Boiler Inspector, Southern Pacific R.R. Co., San Francisco, Calif.

SILVER HELPS PROTECT US FROM GAS ATTACKS

America has never made a habit of starting trouble; but if we have to we are always ready to finish it. We will not start gas warfare, but we are ready for it. The Chemical Warfare Service is fully prepared to protect our armed forces with a gas mask which will carry them through any form of gas attack.

The gas mask consists essentially of a box in which chemicals are placed, called a canister. A filter removes the extremely small solid and liquid particles which float in the air, and the chemical filling in the canister extracts toxic vapors. The air breathed by the wearer enters the canister, passes through the filter and the chemical filling, and then through the tube to the helmet covering the eyes, nose and mouth.

The C.W.S. has equipped every combat soldier in the United States Army with the latest type gas mask, assuring adequate protection from all known war gases and military smokes. Four main types are

(*Continued on page 822*)

"LET 'ER GO!"

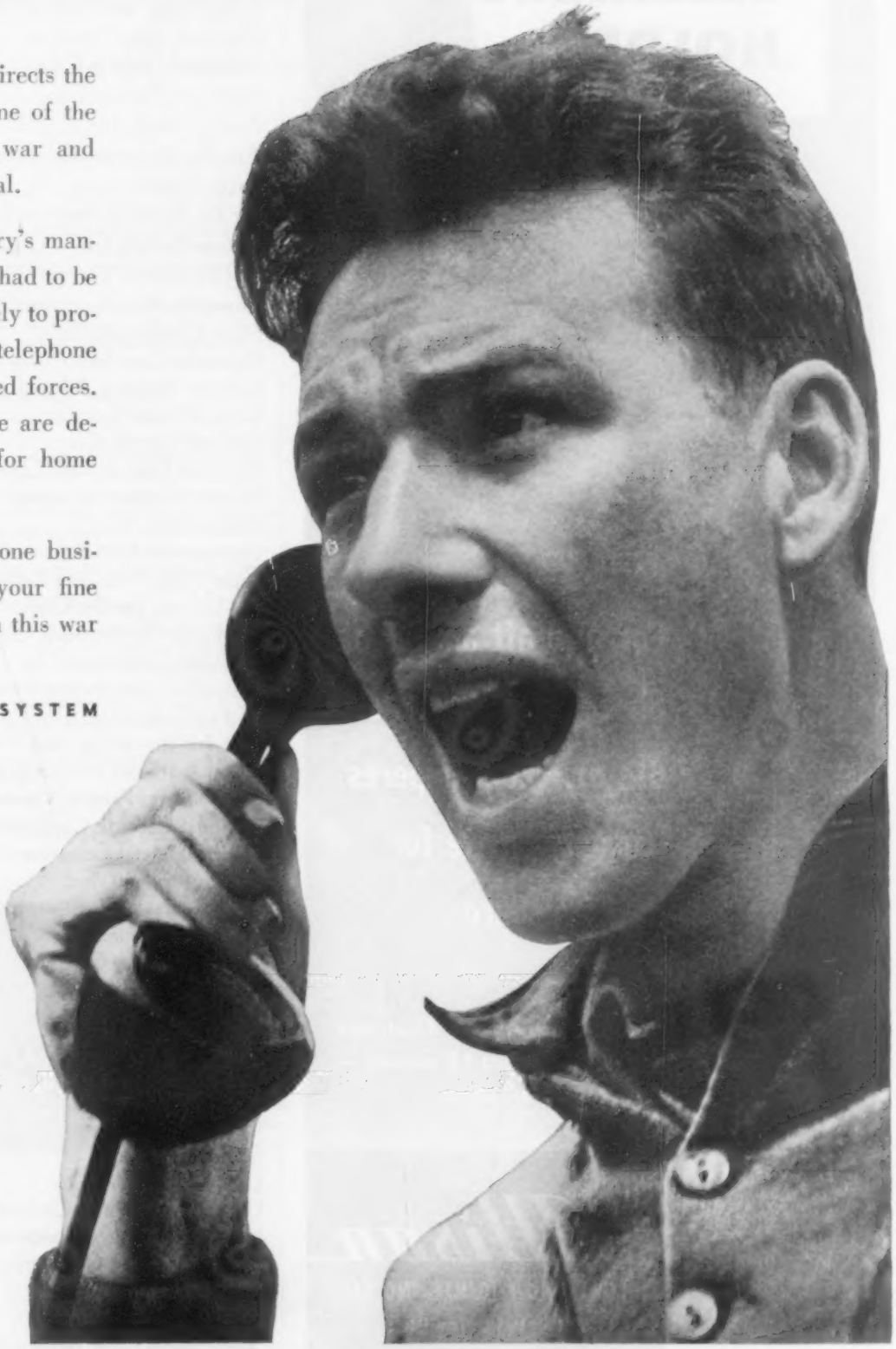
Over the telephone he directs the firing of big guns on one of the fronts. This is a vast war and communications are vital.

So the telephone industry's manufacturing capacity has had to be devoted almost exclusively to producing electronic and telephone equipment for our armed forces. That explains why there are delays in filling orders for home telephones.

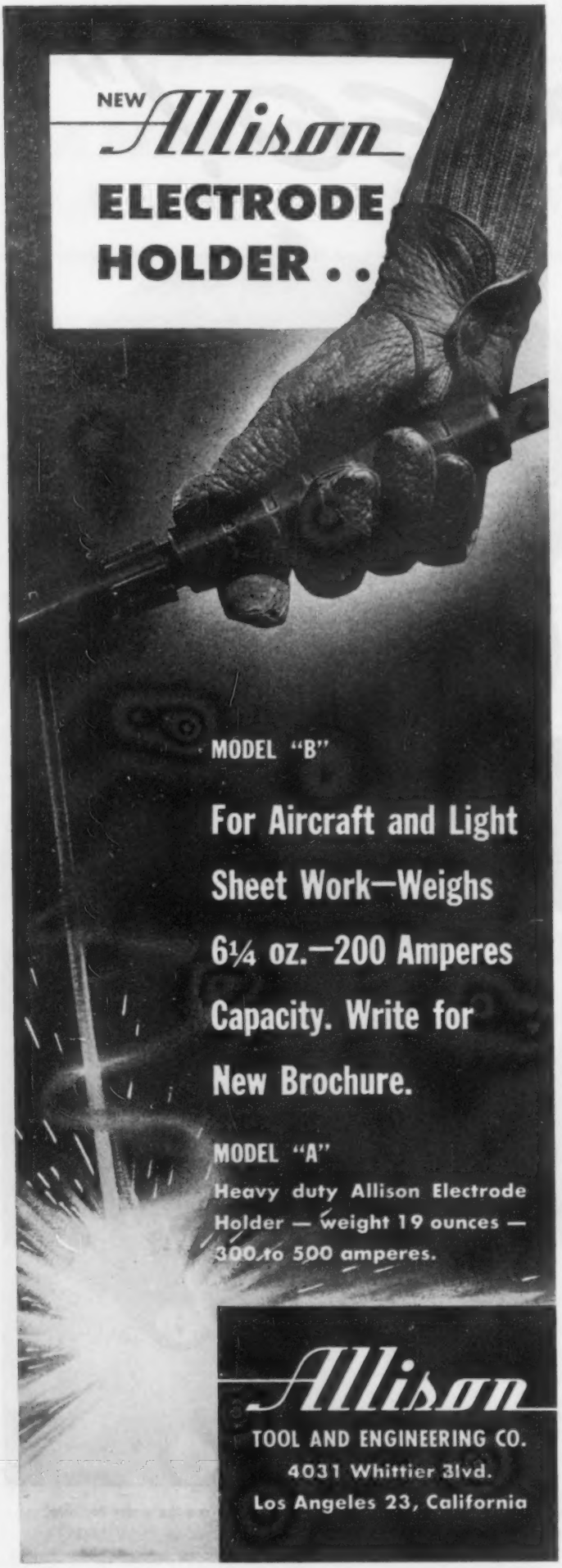
All of us in the telephone business are grateful for your fine spirit of co-operation in this war emergency.

BELL TELEPHONE SYSTEM

Please try to keep the Long Distance circuits clear from 7 to 10 each night for the service men and women.



The big guns start booming when the section chief of a cannon company gives the order to "fire"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HOLDER . .
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For Aircraft and Light Sheet Work—Weighs 6¼ oz.—200 Amperes Capacity. Write for New Brochure.
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Heavy duty Allison Electrode Holder — weight 19 ounces — 300 to 500 amperes.
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Exhaust manifolds on Pan American Clippers show high resistance of welded Inconel sheet to heat, corrosion, and intense vibration

Steady and intense "shivering" at 1500° F., is a tough combination for *any* welding job to stand.

Yet records of *more than 5000 hours flying service without repair* have been set by exhaust manifolds welded of light gauge Inconel sheet, and used on Pan American Clippers under these conditions.

The high properties of Inconel . . . the INCO Nickel Alloy especially recommended for high temperature service under stress . . . contribute greatly to this remarkable service record. And so does the *care* with which the welding is done.

PREPARATION FOR WELDING

As a rule, the joints are butt, edge and fillet welded. In all cases, true-fitting joints and clean metal are start-of-the-job "musts." To insure a uniform weld, space between parts to be joined is kept equal from one end to the other.

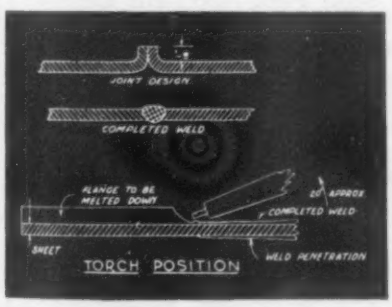
Edges of sheet metal for edge welds require a sharp right-angle bend, with the height of the edge from 1 to 1½ times the thickness of the sheet. The sharp corner is necessary to insure good penetration inside the manifold. If rounded corners are used on the drop hammer for easier forming, they are squared prior to welding.

ROD AND FLUX

For *true* Inconel welds, No. 42 Inconel Gas Welding Rod (usually 1/16" diam.) and Inconel Gas Welding Flux are used. This insures a weld with strength and corrosion-resistance equivalent to that of the parent metal.

The Inconel Flux, a dry powder, is mixed with thin shellac solution (1 part of 3 or 4 lb. cut liquid shellac with 5 parts of alcohol, by volume), and is mixed to buttermilk consistency and stirred every time it is used. Only enough for a half-shift's work is prepared at one time.

The flux is applied both to the top and under side of the joint to be welded. After a thin film of flux is applied to the edges of the parts, they are assembled and tacked. One or two extra applications of the flux are applied to the under side of the joint, to provide a mold for the molten weld metal and to insure complete and uniform penetration.



APPLYING THE FLAME

A soft oxy-acetylene flame with a slight excess of acetylene extending 1/32" to 1/16" beyond the tip of the luminous cone is found most effective. The torch is weaved or held steady, as the welder prefers. In making butt joints or fillet welds, the torch is held at about 30° to 45°, with the flame point toward the unwelded joint . . . that is, *forehand* welding.

GOOD WORKING PROPERTIES . . . GOOD WELDING PROPERTIES *are definite advantages of Inconel. It can be formed into complicated shapes in drop hammer as well as in press work, and welded to produce ductile joints that endure constant vibration without cracking.*

In making edge welds, the torch is laid down at an angle of 15° or 20° with the sheet, or practically flat. Thus the edges about to be welded are pre-heated by the long oxy-acetylene flame. Again, care is taken that uniform penetration is obtained.

In making a lap welded joint, such as attaching the flange to the inlet port tube, both the inside and outside of the material to be welded are fluxed. Care is taken that the weld does not penetrate or break through the under surface of the lap joint, which would offer a focal point for fatigue failure.

THE FINISHED WELD

A properly made weld is even and clean-cut in appearance. The penetration is uniform and the surface of the penetrating weld metal is bright.

ELECTRIC WELDING OF INCONEL

Although electric arc welding is seldom used in aircraft manifold construction because of the thin sheet sections and types of joints used, Inconel sheet is readily welded electrically. Covered Inconel electrodes are available which produce strong, sound ductile welds.

For further information about the welding of Inconel or other INCO Nickel Alloys, address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York 5, N. Y.**

NICKEL INCO ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings

(Continued from page 818)

issued—the Service mask, the Training mask, the Diaphragm mask and the Optical mask.

The service mask can be worn fairly comfortably for a long period, whether the man is active or inactive. It permits special, close-fitting glasses, furnished by the Medical Department, to be worn therein. The Diaphragm mask permits verbal orders to be given and conversation to be carried on by the wearer. The training masks for instruction purposes have canisters attached directly to the facepiece. The Optical mask, with canister worn at the back of the neck, has adjustable eyepieces for the convenience of men who, in the course of duty, must use binoculars and fire control instruments.

REGULATOR BULLETIN

A new bulletin illustrating the design and construction features of certain types of Victor Single and Two-Stage Reduction Regulators employed in the welding industry has been released by Victor Equipment Co., 844–54 Folsom St., San Francisco.

This particular bulletin will be of definite interest to many engineers and welding department heads. It deliberately discloses design and construction details which are altogether too often hidden from the view of the prospect who receives simply written claims instead of supportable evidence.

Copies are available to all interested individuals upon request. Specify Form 40.

DR. OEHLER PROMOTED

Appointment of Dr. I. A. Oehler as Chief Process Engineer of the American Welding & Manufacturing Co., Warren, Ohio, is announced by W. J. Sampson, Jr., President. Prior to joining the American Welding staff more than a year ago, Dr. Oehler was open-hearth metallurgist of the Buffalo District of Republic Steel Corp.

Dr. Oehler was graduated from Rensselaer Polytechnic Institute in 1935 with degrees of master of electrical chemistry and doctor of electrical metallurgy. He taught mathematics and metallurgy at Millard-Fillmore College of the University of Buffalo, and has contributed articles to various technical publications.

Dr. Oehler has recently been appointed a director of the Warren Chapter of the American Society of Metals.

16TH NATIONAL POWER SHOW TO BE HELD IN MADISON SQUARE GARDEN

Announcement has been made that the 16th National Exposition of Power and Mechanical Engineering will be held in Madison Square Garden, New York, November 27 to December 2, next. This year's event will be keyed to the effective solution of continuing war production problems, particularly those caused by sudden shifts in military needs, demanded by the ever-changing scenes in Europe and Western Oceania. It will also provide informational sources for the advancement of postwar planning.

Held biennially, the National Power Show, as it is commonly known, is widely recognized as an effective institution for the development of more effective utilization of the Nation's power resources. The last Exposition, held in 1942 in the midst of war work, proved exceedingly helpful to a wide range of new visitors, greatly expanding the service to industries in all fields. It is anticipated that this year's Exposition will attract an even larger number of engineers, executives and operating personnel concerned with current production problems as well as preparations for civilian pursuits.

More space has been provided than at the last Exposition, the number of booths has been increased and advance bookings up to the middle of July ensure a greater number of individual displays than in 1942 with a probable waiting list before Fall.

As heretofore, the Exposition will be open by invitation and registration to visitors directly associated with power and production operations, but closed to the general public. No admission fee will be charged.

2400% Profit!

THE Sight Feed Acetylene Generator pictured herein has been on the job, indoors and out, for more than 20 years. Its owner says it has brought him more than a 2400% return on his original investment. Maintenance expense has been less than $10 in all the 20 years of trouble-free, profit-making service. Sight Feed will do as well for YOU in the next 20 years. Order today.

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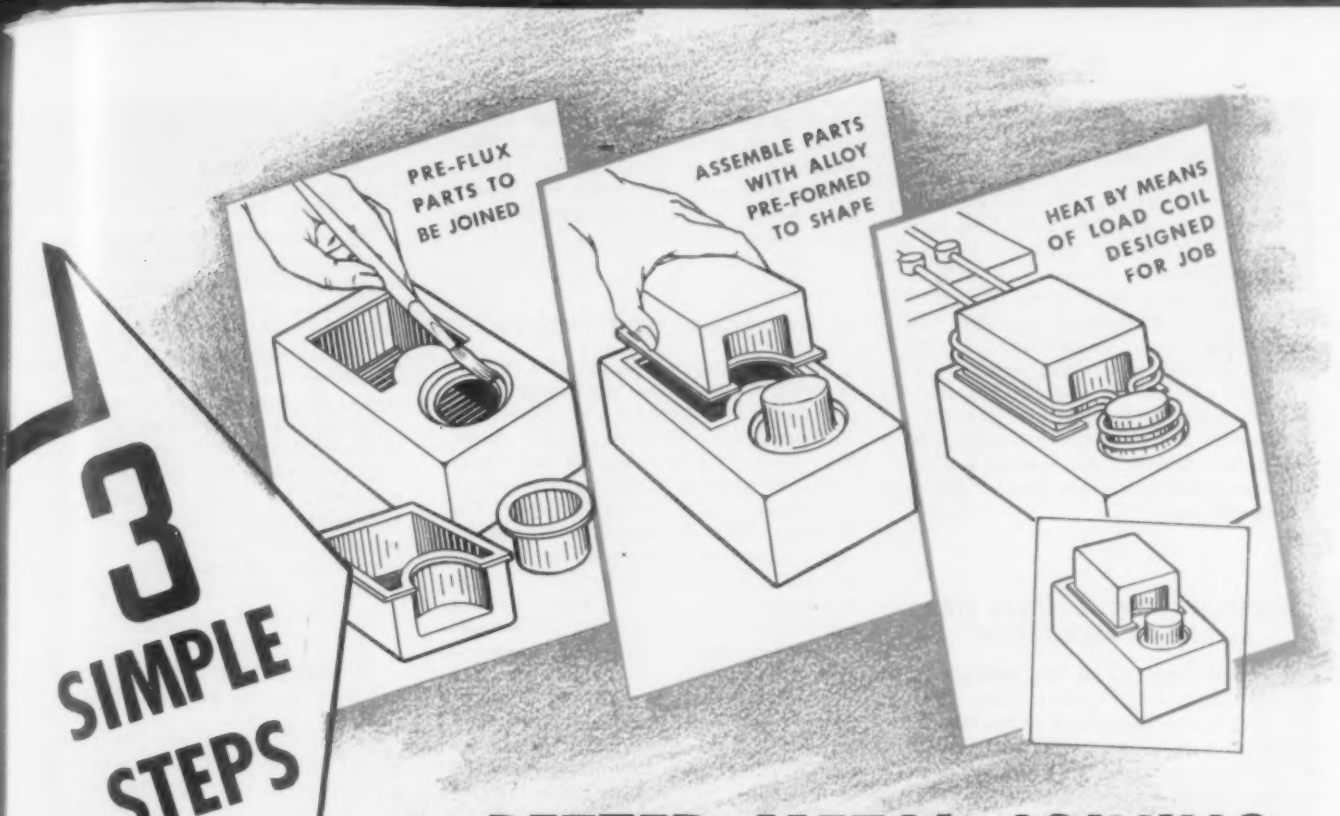


3 SIMPLE STEPS to BETTER METAL JOINING — *FASTER* and at LOWER COST

SEE THE LEPEL UNIT IN OPERATION

Booth H-610

National Metal Congress and War Conference Display

Public Hall, Cleveland
October 16-20

Many manufacturers, seeking faster and better methods of assembling metal parts to meet war production demands, have found the answer — and important economies — in brazing and soldering by the Lepel Induction Heating process.

Using brazing and soldering alloys of any melting point, Lepel Induction Heating reduces the most intricate metal joining jobs to three simple operations, so easy that women or unskilled workers can perform them with a minimum of training. Frequently, intricate jobs, impractical by other metal-joining methods, can be performed in a few seconds — often with gang set-ups that raise production to astounding levels.

Quality is improved because the human element is eliminated, time cycles are automatically controlled, and the heat is generated within the metal, assuring thorough penetration of the alloy.

"Runs" are rare since only the required amount of alloy is used and, since excessive heating is impossible, discoloration is minimized and scaling practically eliminated. Thus, little, if any, cleaning up or refinishing is necessary.

If you have a metal joining problem — present or projected — involving ferrous or non-ferrous metals, or both, a Lepel field engineer will be pleased to call to discuss the advantages and possibilities for economy which Lepel Induction Heating offers.

LEPEL HIGH FREQUENCY LABORATORIES, INC.
PIONEERS IN INDUCTION HEATING
39 W. 60th STREET NEW YORK 23, N. Y.

ANTI-SPATTER FLUID BULLETIN

A new engineering bulletin, describing in detail the practical and scientific tests made to determine the effects of using an antispatter fluid in welding, has just been issued by The Midland Paint and Varnish Co. of Cleveland, Ohio. This bulletin contains a concise report of a process used by a large metal fabricator to reduce mill scale formed during normalizing. It suggests a method of keeping welding jigs free from spatter. It also contains laboratory reports (fully illustrated) on tests for determining weld strength and weld soundness. Of particular interest is a report concerning the suppression of fumes during welding.

RESEARCH PROMOTES VITAL WAR AND PEACE PRODUCTION

Research activities of the Babcock & Wilcox Tube Co., Beaver Falls, Pa., which have seen the growth of the laboratory from a one-room shanty with a staff of three persons, to a $300,000 fully equipped modern building with a personnel of more than 70 persons, were credited on the approaching 25th anniversary of the laboratory, for helping to supply the United Nations, on an unprecedented scale, with many kinds of tubing, one of the country's most vital wartime products, according to H. D. Newell, Chief Metallurgist and Director of the Laboratory. Today, with the plant operating at full blast to turn out vital materials for the U. S. Navy, the U. S. Army, the Merchant Marine and Air Forces, is a far cry from the early days in 1919, when Mr. Newell, then a young chemist-metallurgist, first came to the company.

"STORAGE BATTERY" WELDING

In an effort to provide detailed answers in print to the most commonly asked questions about its new process of welding with storage batteries as a power source, Progressive Welder Co., 3050 E. Outer Drive, Detroit 12, Mich., has released an illustrated 12-page booklet entitled "The How and Why of Storage Battery Welding." Some 35 major questions relating to costs, operation, maintenance, design, installation, etc., of "battery" welding equipment as developed for the various forms of resistance welding are answered in this new booklet.

According to the booklet, the new battery welders can be effectively used on any material capable of being resistance welded, including aluminum, stainless steels, alloy steels, carbon steels, brasses, etc. Each welder unit, being completely self-contained, can be made portable and moved about in a factory. In most cases, a maximum of 10 to 20 amp. or less from a 220- or 440-v. line is all that is required to keep batteries charged under service conditions, it is stated.

As to operation, trained technicians are unnecessary to run battery welders. Moreover, since use of battery welders eliminates the need for the high voltages required with other forms of resistance-welding equipment, increased operator safety is provided.

It is claimed that battery operated welders represent the simplest form of resistance-welding equipment available. Little maintenance is said to be required aside from a weekly filling of the batteries with water, and any good mechanic can service virtually any part of a battery welder, according to the booklet.

Initial cost is lower than for other types of stored energy welders. Operating costs are also lower due to the unit's high efficiency, lower total current consumption, and because battery welders make possible a 95% reduction in peak line demand charge by Public Utilities compared with other stored energy types.

GREAT AXIS FIRES STARTED BY SILVER BRAZED BOMBS

One of the many incendiary weapons forged by the Chemical Warfare Service for use against the Axis is the special 100-lb. oil bomb used by our Air Forces in raids to soften enemy strongholds and to support our attacks by land and sea forces.

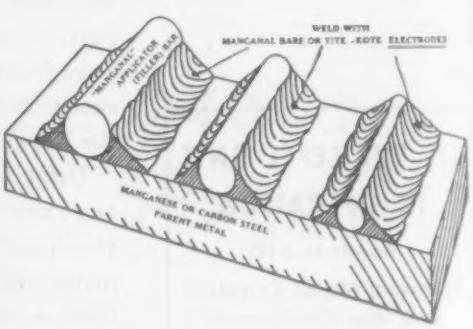
The 100-lb. bomb is designed mostly for use against oil refineries, oil dumps and ammunition dumps for starting great fires to wipe out enemy supplies. Bombs of

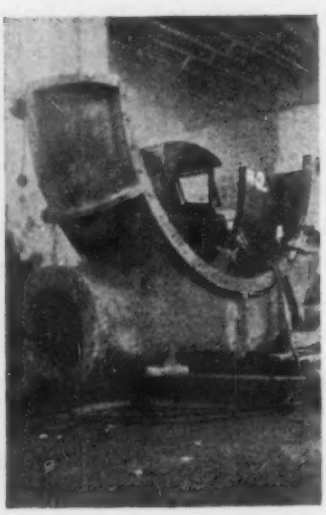
(*Continued on page 830*)

MANGANAL

TRADE MARK REG. U. S. PATENT OFFICE

11 to 13 1/2" %
MANGANESE NICKEL STEEL
APPLICATOR BARS


WELD WITH
MANGANAL BARE OR TITE-ROTE ELECTRODES
"MANGANAL" APPLICATOR (FILLER) BAR
MANGANESE OR CARBON STEEL PARENT METAL



22" PUMP SHELL REBUILT WITH APPLICATOR BARS

Rounds 3/8", 1/2", 5/8", 3/4", 7/8", 1", 1 1/8", 1 1/4", 1 1/2"
Squares 1/2", 5/8", 3/4", 7/8", 1", 1 1/4"
Flats 2 x 3/8" 3 x 1/2" 3" x 1"
3 x 3/8" 4 x 1/2" 4" x 1"
4 x 3/8" 4 x 3/4" 6" x 1"
1 x 1/2" 6 x 3/4" 8" x 1"
2 x 1/2" 2 x 1"

Stock lengths 16 to 20 Feet
(*Order From Your Nearest Distributor*)

Sole Producers

STULZ - SICKLES CO.
134 Lafayette St., Newark 5, N. J.

Large illustration shows Magnaflux Inspection of welds in large blower. Inset shows indication of defect (seen as black mark) in weld of blower.

...by Magnaflux* Inspection

To be able to tell positively *by just visual inspection* that this weld is perfect, or that one is likely to fail in service, is made possible by Magnaflux. Portable equipment, easy and simple to use, permits rapid, *non-destructive* testing of all welds, anywhere in the plant or yard.

Special techniques and special equipment have been developed by Magnaflux to meet the varying conditions met in the inspection of aircraft welding, structural welding and welding of pressure piping and pressure vessels.

For a full explanation of Magnaflux welding inspection...its positive indication of defects...its inexpensiveness . . . get our complete bulletin now. Write today.

Positive indications of welding defects provided by Magnaflux Inspection cover: (1) surface cracks in weld or parent metal; (2) lack of fusion—incomplete penetration; (3) large slag inclusions.

*Magnaflux—a Trade Mark of the Magnaflux Corporation applied to its equipment, materials and inspection methods.

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MAGNAFLUX CORPORATION

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(Continued from page 824)

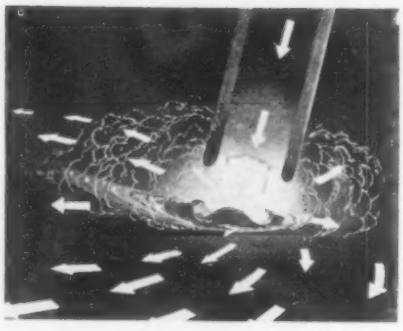
this type were used against the Rumanian oil fields in the famous Ploesti raid.

Within the bomb is the M-13 burster unit, which has four parts brazed with Easy-Flo, a special silver alloy developed by Handy and Harman. The quantities in which this bomb is used may be imagined from the fact that the quantity of silver brazing alloy consumed in its production has so far been over 100,000 oz., using only an infinitesimal amount of silver on each bomb.

A.-C. WELDING MOVIE FILM

A new two-part, all-color sound movie "The Story of A.-C. Welding," which is expected to increase materially the already large number of users of the a.-c. arc-welding process, has been announced by the General Electric Company. The new 16-mm. movie has been made available to all G-E arc-welding specialists and distributors, who will arrange to exhibit the film on request. The film requires about 35 min. to exhibit.

Produced by the Raphael G. Wolff Studios, Hollywood, under the technical supervision of the G-E Laboratories, the film tells in detail, for the first time, the complete story of a.-c. arc welding and its many advantages. Expert welders demonstrate in scores of actual production-welding scenes the speed, flexibility and efficiency of the a.-c. process in all positions and on all types of joints. Laboratory demonstrations and clear close-ups of the arc and the molten steel show how the



Type of Animated Sketch Used in Movie "The Story of A-C Welding" to Illustrate in a Popular Manner the Technical Points of A-C Welding.

troublesome arc blow, so characteristic of d.-c. welding, is eliminated by the use of alternating current. Animated sketches, interspersed at intervals, illustrate some of the more technical points in a popular manner.

The movie opens with an interesting and informative comparison between a.-c. and d.-c. welding which strongly emphasizes the basic differences between the two processes. What arc blow is, how it interferes with production, and how it is counteracted by a.-c. welding is next shown. Then the four major factors of a.-c. welding technique—current setting, travel speed, length of arc and angle of electrode—are demonstrated in a series of brilliantly photographed close-ups. The advantage of using large electrodes and higher currents, made possible by a.-c. welding concludes Part I of the film.

Part II begins with a detailed portrayal of the numerous profitable applications of a.-c. arc welding. Scene after scene depicts how the a.-c. process results in faster production, easier welding, lower cost and more uniform high-quality welds on thick or thin material, in manual or machine welding, in any position, indoors or outdoors.

Following this is a demonstration of how arc-blow affects the quality of the weld when the d.-c. process is used, especially in corners and at the ends of the joints, and makes it difficult for the operator to control the arc and the molten pool. Next a series of scenes shows in detail how readily a.-c. welding lends itself to the use of larger electrodes and higher currents. A number of close-ups demonstrate the faster speed obtainable with the larger electrodes. The film closes with illustrations of the savings in power and maintenance obtained by users of a.-c. arc welding.

OPEN STEEL GRATING AND STAIR TREADS

A book of complete, up-to-the-minute information on open steel grating and stair treads has just been issued by Wm. F. Klemp Co., steel flooring specialists, 6601 S. Melvina Ave., Chicago 38, Ill.

Profusely illustrated with photographs of the products in actual plant and building uses, it adds to detailed construction particulars, drawings and tabular specifi-

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Aircraft & Accessory Plants

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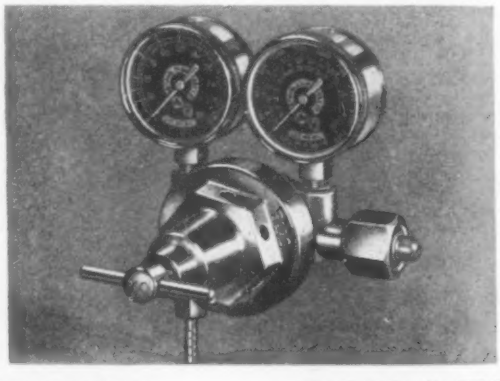

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REGO Gas Plant Equipment to be safe, must be made of brass and other critical metals. Conserve your equipment. You may not get more.

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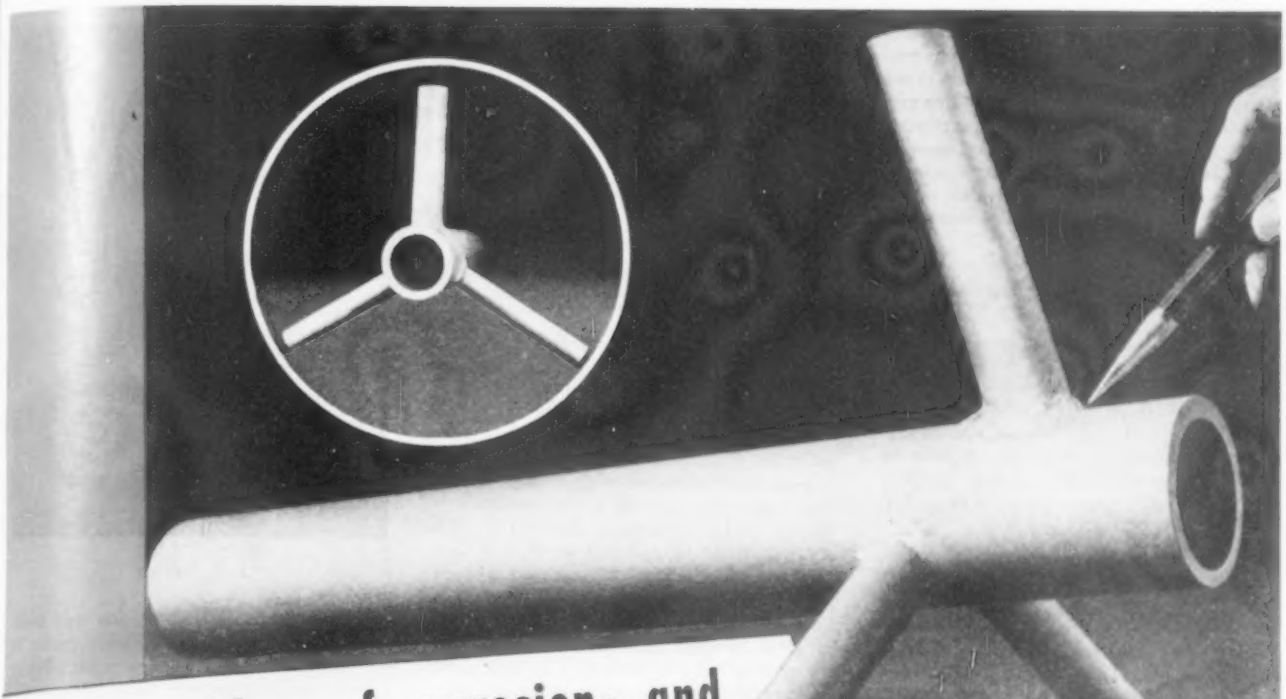
Pioneers and Manufacturers of Precision Equipment for Using and Controlling High Pressure Gases



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Here is another successful application of Ampco-Trode, to complete the fabrication of a corrosion-resistant unit. In this particular case, and in the original construction of many other types of equipment where metal is exposed to corrosion, wear, shock, or fatigue, Ampco-Trode coated aluminum bronze electrodes deposit weld metal comparable in strength, ductility, and hardness with the various grades of cast Ampco Metal—and successfully weld almost any combination of dissimilar metals, giving a weld with excellent physical properties. Five grades of Ampco-Trode are available to meet your specific needs. With tensile strength up to 80,000 psi and hardness to 352 Brinell, Ampco-Trode is recognized as ideal for such purposes as illustrated above.

Nation-wide distribution enables you to secure Ampco-Trode quickly. Consult with your supplier or write us for information.

W-76

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cations, providing full installation data for every requirement. Subjects covered are the uses of riveted and welded types of grating for open steel flooring, stairways, stair treads, fire escapes, loading platforms, decks for bridges and ships, automobile wash racks, drains, catwalks, tower-stairs, boiler and engine rooms, sidewalks, partitions, in all, nearly fifty of the numerous distinct services.

A copy may be had without charge by addressing the Wm. F. Klemp Co.

FROM ABROAD

The SOCIETY is in receipt of a letter from Mr. H. W. G. Hignett of The Mond Nickel Co., Ltd., London, in which Mr. Hignett wishes the SOCIETY success in connection with its 25th Annual Meeting and wishes to be remembered to his many friends.

ARC AND ACETYLENE WELDING
Basic Procedures

By Harry Kerwin. Publishers, McGraw-Hill Book Co., New York, Price $2.50. A book designed for the use of the general shop instructor or the beginning student, to lead him through the exact step-by-step procedure necessary to make an acetylene or electric weld.

Special welding techniques are stressed, for the author insists that the student must master the actual manipulative technique of welding before he can hope to advance to the welding of alloy metals, or intelligently study construction and joint design as applied to welding. Practical methods are given for controlling expansion and contraction, low-heat brazing, alloy welding and pattern layouts.

By thorough study of the text, the student will shorten his training period and eliminate many hours of useless practice spent on the wrong procedure—and will know not only how to make a good weld but will also know when a weld is good.

LEVAN PROMOTED

E. E. LeVan has been elected President of Haynes Stellite Co., a Unit of Union Carbide and Carbon Corp., succeeding the late Francis P. Gormely.

Mr. LeVan was graduated from Pennsylvania State College in 1917, with a degree in mechanical engineering. After spending five years as a mechanical engineer with Bethlehem Steel Co., he entered the employ of Haynes Stellite Co. as a sales engineer in 1922, becoming chief engineer three years later. In 1927 Mr. LeVan entered the sales department, and in 1929 became general sales manager. He was elected vice-president in 1939, and on May 22, 1944, was made vice-president and general manager, and a director of Haynes Stellite Co. Mr. LeVan will continue to make his headquarters at Kokomo, Ind., where the general offices and plant of Haynes Stellite Co. are located.

For many years Mr. LeVan has taken a leading part in making available to industry the advantages of the Haynes Stellite chromium-cobalt-tungsten alloys and other special alloys and metals for resistance to abrasion, corrosion and heat. Remarkable progress has been made in this field during the past few years. Many developments, however, now are unavailable for general use for the duration of the war, since practically all of these have been of extraordinary importance to the armed services, particularly the Navy and the Army Air Corps.

E. E. LeVan

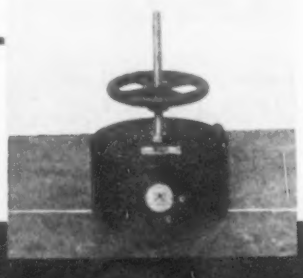
Mr. LeVan is a member of the Society of Automotive Engineers and the American Petroleum Institute. He is the author of a number of articles on metallurgical and mechanical engineering subjects.

WELDERS — SHIP FITTERS — PLATE FABRICATORS —

SPEED WELDING OPERATIONS
SAVE TIME, LABOR AND MATERIALS WITH
HERCO MAGNETIC ALIGNERS

Herco Aligners magnetically true-up and hold firmly in welding position, plates, beams, rods . . . eliminate time-consuming manual aligning, welding of temporary clamps, wedges or use of heavy weights to hold in position the parts to be welded. Hooked up to either AC or DC power, Herco Magnetic Aligners do the work normally required of a full man crew . . . in almost no time and with precise efficiency.

Herco Aligners are simple to operate, easy to handle and have a magnetic pull of 2,000 pounds per surface inch on one inch plate. Further details will gladly be sent on request.



ALIGNING BUTT END PLATES FOR TACK WELDING

A Herco Aligner is placed squarely on the seam and when energized instantly draws both plates flush against the perfect surface of the magnet, thereby trueing up areas on both sides for tacking.

BUCKLING ELIMINATED BY PRESSURING STIFFENER BEAM

Shipbuilding requires reinforced stiffener beams across each plate at stated intervals. Warped plates are quickly positioned for welding to the stiffener beam by placing the aligner as illustrated.

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MALLORY

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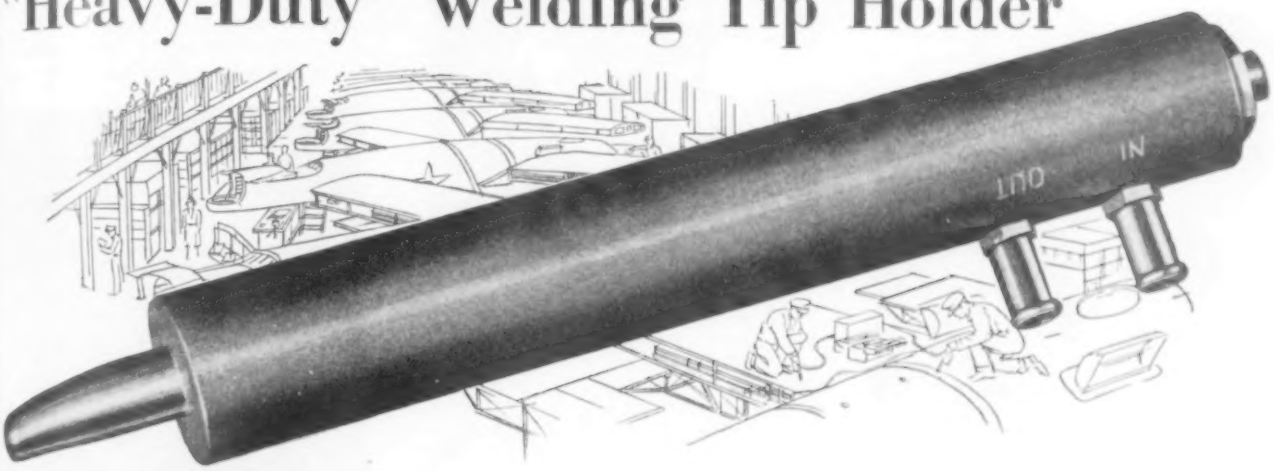
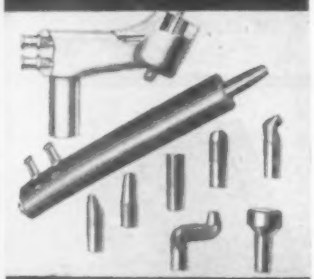


Speedier Production
Less Down Time
Better Welding
Lower Cost



SPOT WELDING TIPS AND HOLDERS

FLASH, BUTT, PROJECTION WELDING DIES

SEAM WELDING ROLLS

Today's increased production calls for resistance welding tip holders that are able to stand up under gruelling service. Mallory answers the need with a product that lives up to its name—the Mallory "Heavy-Duty" Holder.

Carrying an increased flow of water or other coolant, this streamlined, compact tip holder keeps tip temperatures down and increases welding quality and efficiency. Its single piece housing, built to protect vital interior parts, also eliminates coolant leakage troubles.

In addition, the holder features an ingenious knockout device that allows the tip to be ejected quickly by a slight hammer blow at the other end. It has a packing nut, readily accessible at the rear, for quick replacement of packing or adjustments.

The Mallory "Heavy-Duty" Resistance Welding Tip Holder is one of several especially built by Mallory for the tougher jobs of wartime. It has what it takes to stand the gaff.

To get the latest technical information on resistance welding electrodes (for ferrous or non-ferrous metals), write today for your copy of the Mallory Resistance Welding Data Book.

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Buy War Bonds

P. R. MALLORY & CO. Inc.

MALLORY

Standardized Resistance Welding Electrodes

PROGRESSIVE PERSONNEL

In order to provide increased and improved service to users of resistance-welding equipment as well as to provide for anticipated expanded use of resistance welding in postwar times, Progressive Welder Co., 3050 E. Outer Dr., Detroit 12, Mich., has announced the appointment of E. J. Del Vecchio as Field Sales Manager for the organization. Mr. Del Vecchio, who is well known in the resistance-welding field, comes to Progressive Welder Co. from Taylor-Winfield where he was assistant sales manager. He will supervise operation of all field sales activities outside of the Detroit area.

E. J. Del Vecchio

Harry S. Rose

At the same time, Harry S. Rose, formerly Chief Sales Engineer, has been named Sales Manager for the Detroit district. In his new capacity Mr. Rose will not only be in charge of the Detroit district office operations, but will also concern himself particularly with postwar application planning.

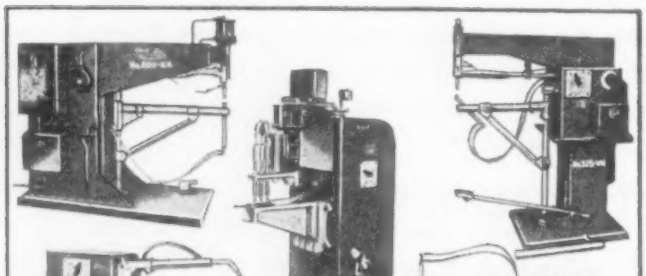
The entire sales organization is being rounded out with the appointment of additional engineering personnel, according to the announcement by Fred Johnson, President of Progressive.

PRIESTLEY PROMOTED

William J. Priestley has been elected President of Electro Metallurgical Co., Electro Metallurgical Co. of Canada, Ltd., Michigan Northern Power Co., and Union Carbide Co. of Canada, Ltd., units of Union Carbide and Carbon Corp. Mr. Priestley succeeds the late Francis P. Gormely.

Mr. Priestley was graduated from Lehigh University in 1908 with a degree in metallurgical engineering, and entered the employ of Bethlehem Steel Corp. He became superintendent of the armor-plate plant and was subsequently division super-

William J. Priestley



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We manufacture a complete line of resistance spot welders from ¼ to 300 KVA for all types of welding. There is an EISLER WELDER for every purpose.

TRANSFORMERS OF ALL TYPES

WE INVITE CONTRACT SPOT WELDING IN LARGE OR SMALL QUANTITIES.

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FREE

ENGINEERING INFORMATION

for BETTER WELDING

This New Engineering Bulletin contains important technical information that may save you time, labor and money on many welding jobs. Learn how to keep welding jigs free of spatter; how to save mill-scale cleaning time after normalizing; how to reduce fumes; etc. etc. Contains actual case histories and laboratory authenticated reports. Write for your copy now.

The MIDLAND PAINT & VARNISH CO.
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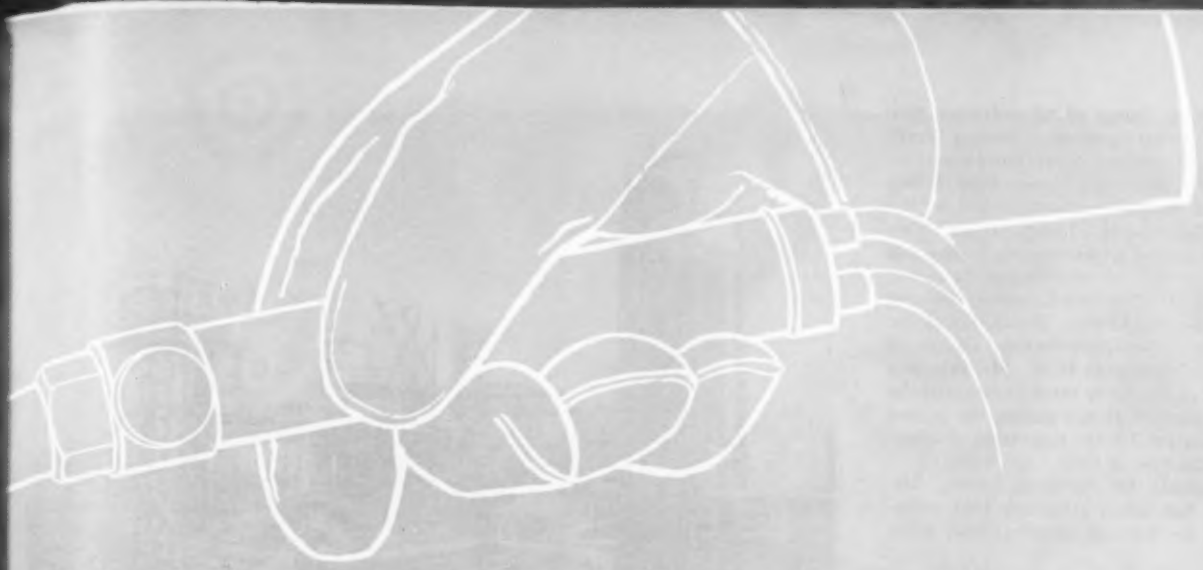

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EUTECTIC *Low Temperature* Welding is NEW! It is one of the most *revolutionary welding developments* of modern times and *The Eutectic Welder* is the only publication that tells you all about it.

Welding at temperatures below the fusion point of base metals is made possible by employing the phenomenon of surface alloying. Joints welded with EUTECTIC *Low Temperature* Welding Rods are *smoother, stronger, better color matched* and *more machinable* than those obtainable *by any other welding or brazing process.*

All metals can be joined by EUTECTIC *Low Temperature* Welding. No special skill is required. All standard methods of heating are employed: gas—arc—furnace and others.

Be the first to introduce the EUTECTIC *Low Temperature* Welding process and its great advantages into your company. Write for *your* copy of *The Eutectic Welder* TODAY! Fill in and mail the coupon or write on your company letterhead and your copy will be sent FREE by return mail. Thereafter you will receive it regularly every month.

The Eutectic Welder is published by the Engineering and Research staff of the Eutectic Welding Alloys Company and is supplemented by valuable contributions from enthusiastic users in all fields of industry and manufacturing.

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intendent in charge of all ordnance production for that company. During World War I, he entered Government service and became the civilian head of the Armor Plate and Ordnance Plant erected by the United States Navy. Later, Mr. Priestley managed a steel plant making high-grade alloy steels for the automotive industry.

In 1923 Mr. Priestley became consulting metallurgist for Electro Metallurgical Co. He became Vice-President in charge of Sales Development in 1932. Mr. Priestley was chief of the Alloy Steel Division of the War Production Board during the period of organization for the expansion of alloy-steel production in 1942.

Throughout his business career, Mr. Priestley has taken a leading part in extending the uses of stainless and alloy steels.

100 OCTANE GASOLINE PLANT

A 100-octane aviation gasoline plant, built at Cleveland on the site where John D. Rockefeller established The Standard Oil Company, Ohio, 75 years ago, was dedicated July 15th by W. T. Holliday, Sohio president, "to an unknown bomber crew of ten young men" whose lives may some day depend on an extra gallon of superfuel squeezed out of this new refinery.

The first of the two 75-ft. fractionating columns on the left serves the three catalytic treating cases seen in the center and the second serves the six cracking cases beyond them, in the distance. Each of the cracking and treating cases contains

Photo courtesy The Standard Oil Co., Ohio

1250 pipes and tubes, representing 15 miles in length, through which gas oil and vapors circulate at temperatures of approximately 870° F. The vapors pass over some 20 tons of catalyst, in the form of tiny chalk-like pellets, in each case. The temperature of the catalyst is kept down by means of molten salt, which circulates in tubes through these cases.

The project, which represents an investment of approximately $10,000,000 employed 55 tons of welding electrodes and kept as many as 60 welders at work in the field at one time. Largest single piece of equipment welded on the site was a 75-ft. synthetic crude fractionating tower, 18 ft. in diameter, which had to be assembled in place because of its size. All pressure vessels, distillation and fractionating columns, etc., were welded.

National

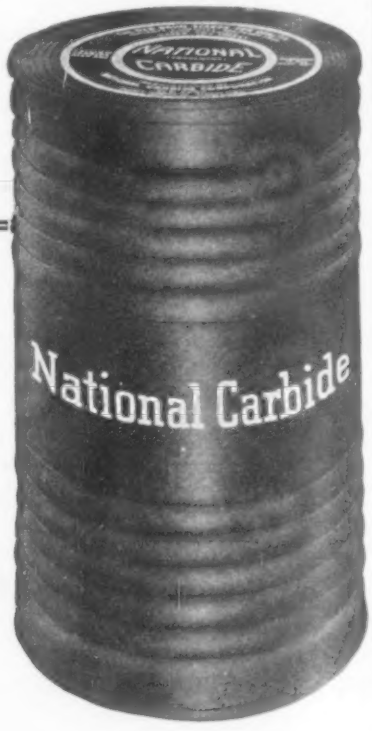
Carbide

IN THE RED DRUM

EFFICIENT

ECONOMICAL

DEPENDABLE



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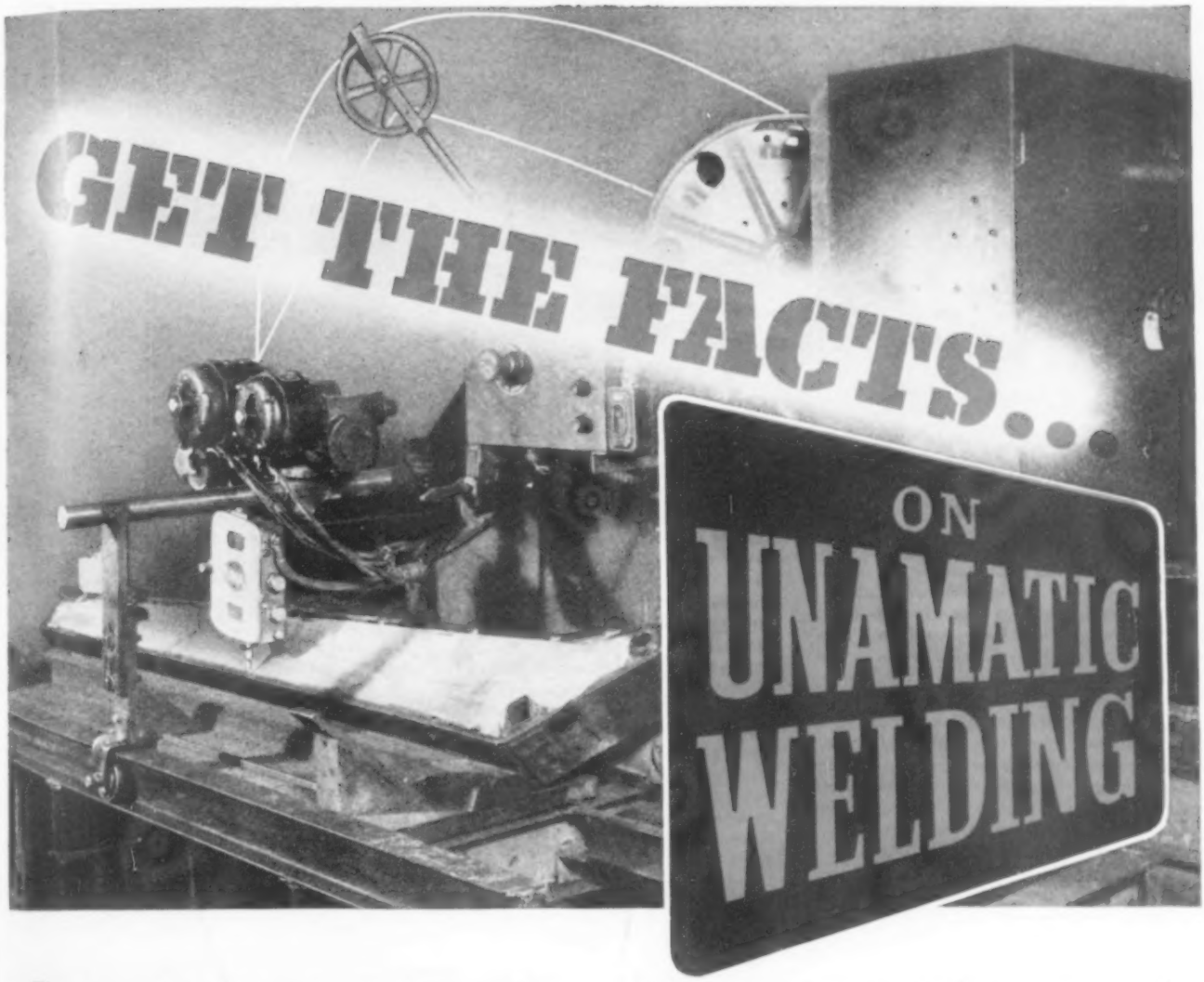

Find out how Unamatic Welding provides more arc welding per dollar of cost by:

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Find out how Unamatic Welding provides distinct advantages in quality over manual welding because of this fact: All functions are mechanically controlled after operating procedure has been established.

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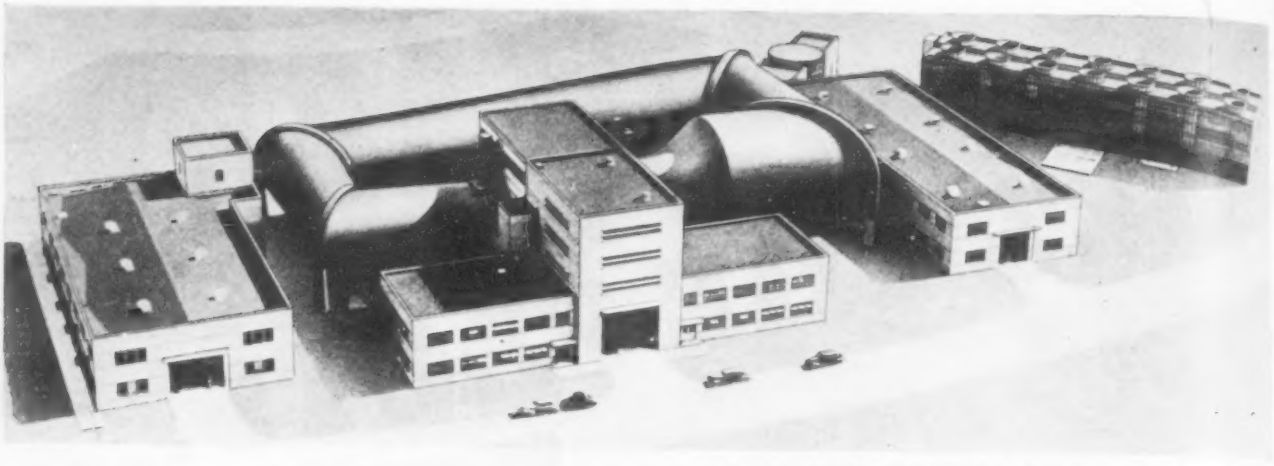


Photo courtesy NACA Aircraft Engine Research Labr. Cleveland, Ohio

Left to Right, Altitude Control Equipment, Altitude Wind Tunnel, Temperature Control Equipment (Largest Refrigeration Capacity in the World), Cooling Towers for Refrigeration Plant

WIND TUNNEL

The Altitude Wind Tunnel of the National Advisory Committee for Aeronautics Aircraft Engine Research Laboratory, Cleveland, Ohio, recently completed by Pittsburgh-Des Moines Steel Co. This is the only wind tunnel of its type in the world. It combines an 18,000-hp. propeller to produce a 500-m.p.h. air stream; pressure control equipment to produce high altitude conditions; and extremely low temperatures encountered in the stratosphere. This tunnel is expected to gain for America a decided advantage in designing aircraft for high altitude flight. The tubular portion of the tunnel, including the test section and the section housing the fans and motors, is of welded-plate construction.

WELDED HULL OF ARMY'S "M-8" ELIMINATES TRUCK CHASSIS

An armored greyhound long kept secret by the Army has been brought into the open with an announcement by the Ford Motor Co. that it has been in mass production for many months in Ford plants at Chicago and St. Paul.

Combining the speed and maneuverability of an automobile with the punch and armored protection of a light tank, the vehicle is designed for scouting and long-range cruising, and bears the "title" of M-8. It is a 6-wheeled, 7-ton scout car that can travel at high speed over almost any type of terrain and is capable of ascending a 45% grade.

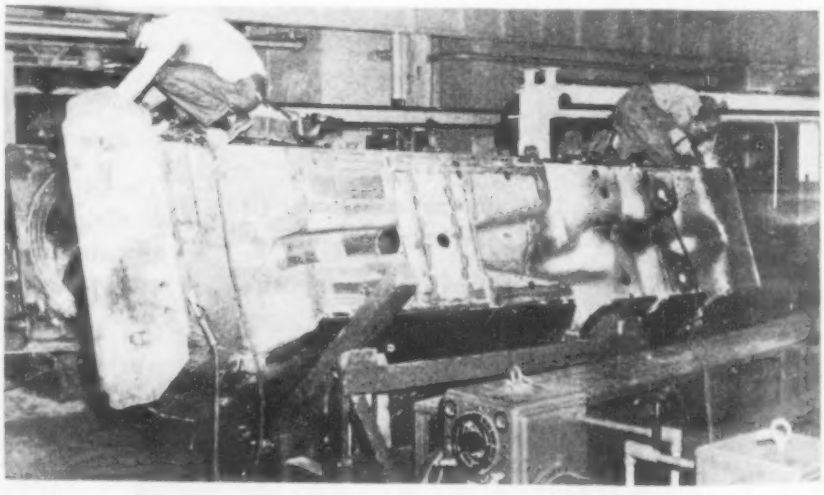
Discarding the conventional type of armored-car construction in which an armor-plated body is built onto a truck chassis, Ford and Army ordnance engineers have fabricated an armored hull by arc welding which in itself serves as a frame. It resembles a turtle back in construction, and the all-welded hull chassis makes it possible for the M-8 to present a much lower silhouette to enemy eyes. Danger of overturning, always prevalent in heavy vehicles, virtually has been eliminated in the lower and wider M-8.

The motor is cradled between two sets of power-driven axles, which make the rear end of the car a 4-wheel drive. When the going gets difficult, the front wheels are engaged and the machine becomes a 6-wheel drive. The rear sets of wheels work on a bogey-type suspension, giving the car extreme flexibility.

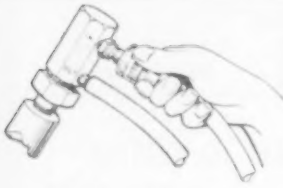
Except for the turret, the M-8 stands less than 5 ft. above the ground and in wheel tread it is more than a foot and a half wider than the average automobile. Even small streams present no obstacle to this vehicle which is capable of traveling through water up to 32 in. in depth.

Designed to out-run everything that it cannot out-shoot, this new weapon is equipped with a 37-mm. antitank gun and a 0.30-calibre machine gun, which move together as a single unit in the manually

Photos, courtesy The Hobart Brothers Co.



Arc Welded Hull of Army's M-8 Serves as Frame, Making Possible the Much Lower Silhouette to Enemy Eyes



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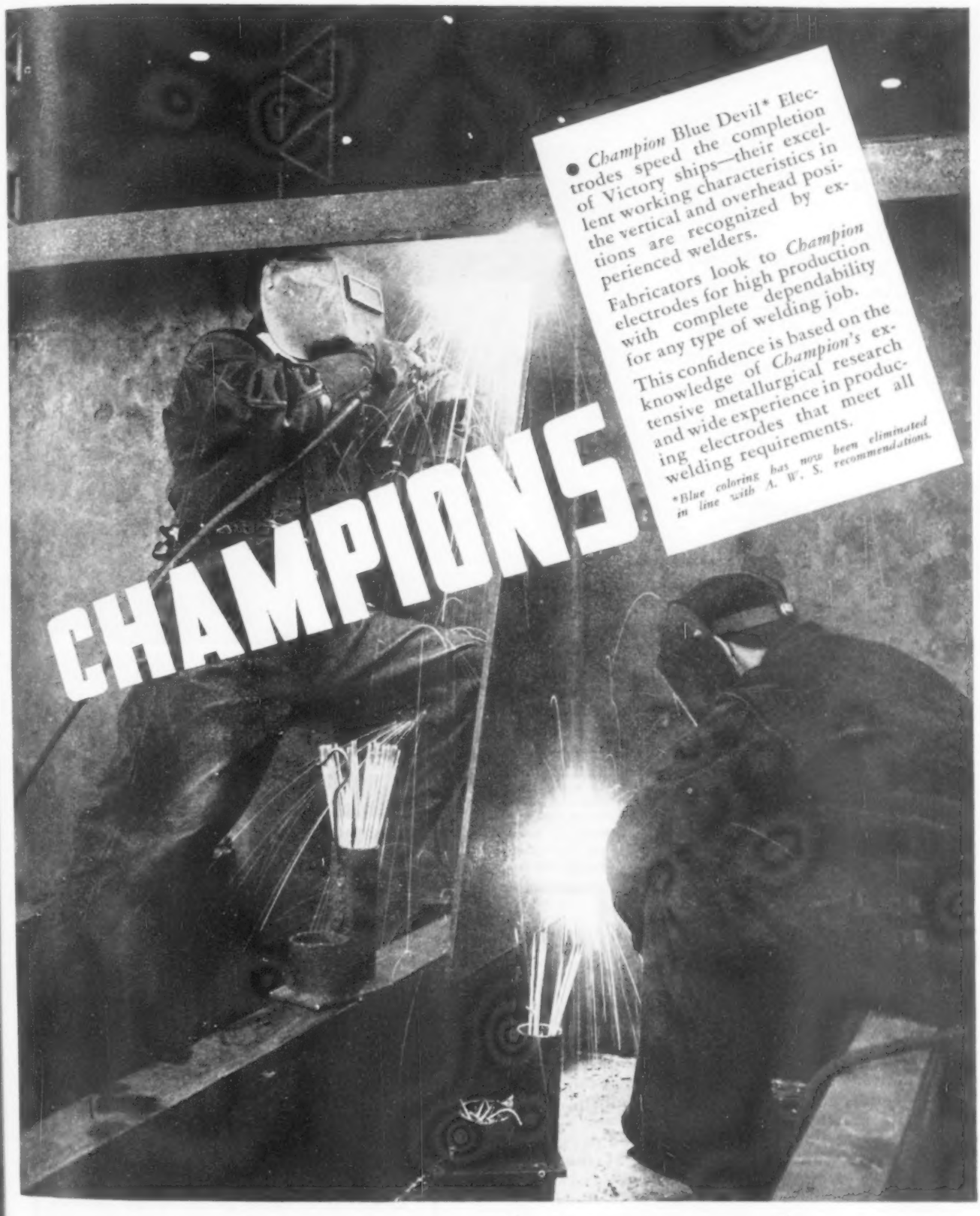
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operated rotating turret. Fitted with special combat tires, the machine can be operated almost normally even though the tires should be punctured by bullets.

DIVERSITY OF WELDING JOBS SHOWS VERSATILITY OF ELECTRIC ARC*

The accompanying photos, taken in a typical metal fabricating plant, illustrate the practically unlimited field of application for electric arc welding in the construction of various items, regardless of size, shape or functional requirements.

Figure 1 shows a substantial increase in production plus important savings in vital aluminum which resulted in the redesign of this 1/4-in. thick cast aluminum housing for a weight scale (left) to all-welded construction (right). Weighing slightly less than the cast item, the welded housing is made of 16-gage press-formed steel sheet,

* Data and photos courtesy The Lincoln Electric Co., Cleveland, Ohio, and Bargar Sheet Metal Co., Cleveland, Ohio.

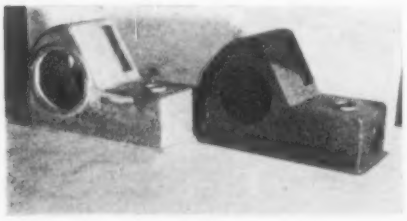


Fig. 1

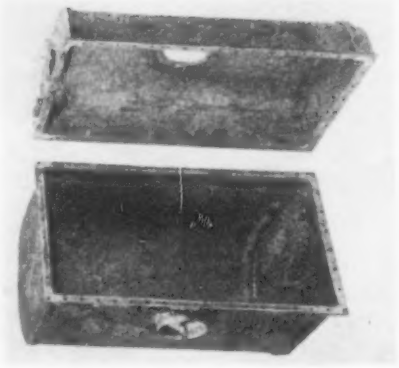


Fig. 2

with two 10 1/2- x 1-in. metal strips welded inside as stiffeners. Measuring 17 3/4 x 8 1/2 x 11 5/8 x 5 3/8 in. overall, the welded structure requires only three pieces of metal per complete housing.

In Fig. 2 is shown a two-piece tank structure, used to house approximately 900 lb. of vital X-ray equipment for the Army, of absolutely oil-tight construction. The tank is of 12-gage steel, formed and tack welded, then solid welded at all joints.

In Fig. 3 frames of 1-in. strap iron, welded adjacent to outside joints, are clearly indicated in this view of the X-ray tank in closed position. The pieces are gasket sealed and bolted at the flanges, all other joints being arc welded with 3/16-in. electrode.

Fig. 3

Split covers for rubber extruder machine are being weld fabricated in Fig. 4. The covers are in two pieces, semicircular, and are constructed by tack welding four 16-gage metal members to form each half of the cover. Pieces are held in position with C clamps while welding with 1/16-in. electrode for mild steel. Final operation

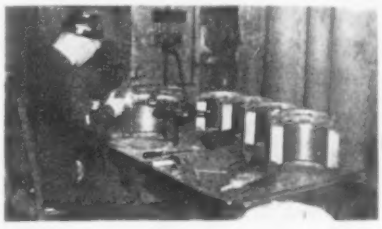
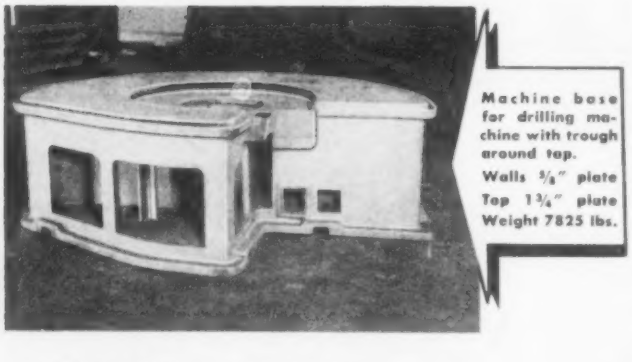


Fig. 4



Machine base for drilling machine with trough around top.
Walls 5/8" plate
Top 1 3/4" plate
Weight 7825 lbs.

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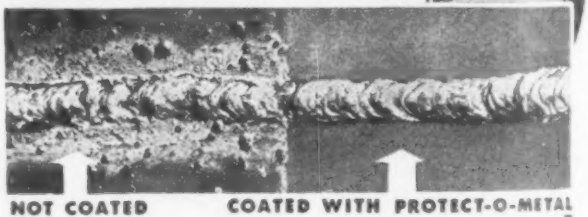

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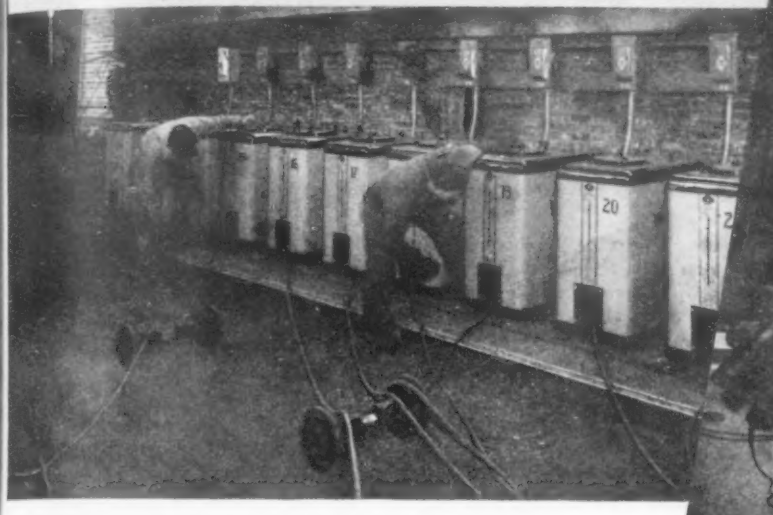

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TRANSFORMER AC WELDER

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2. It's also highly recommended by the majority of manufacturers of automatic welding units as an ideal transformer to use with their equipment. A number of 300 or 500 ampere "Bumblebee" machines, connected in parallel, will furnish ample power for your automatic welders.

This flexibility offered by the "Bumblebee," plus its sturdy, trouble-free construction – high electrical efficiency – and improved power factor, make it an excellent welder for every modern metal-working plant. Be sure to mail the coupon for free catalog that gives full details. Other Wilson AC welders are made in sizes from 100 to 1000 amperes.

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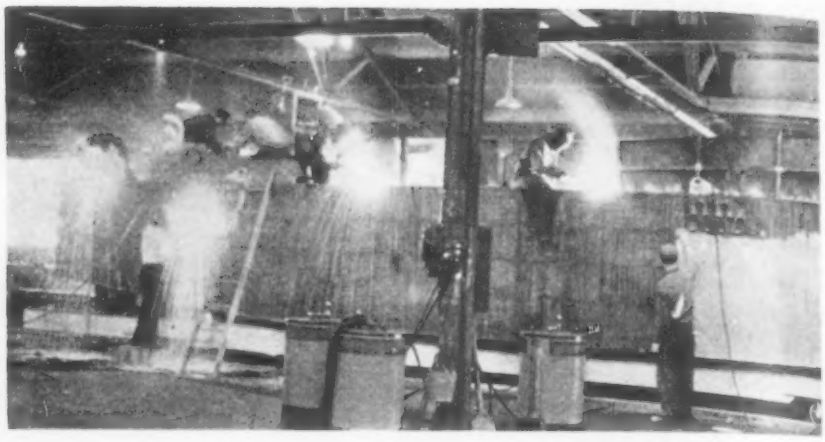
CITY ..... STATE .....

Fig. 5



Welding the Various Subassemblies Into Place Before the Barge Is Righted, a Prime Coat of Paint Is Being Applied Even Before the Welding Is Completed

involved packing loose rock wool between inside and outside walls of cover for insulating purposes. The complete cover has an outside diameter of 13 in. and is $9^1/_2$ in. in length.

Simplicity of design marks the construction of this large welded metal cabinet for an automatic machine (Fig. 5). Measuring 40 by $20^1/_2$ in. in width and depth by nearly 5 ft. in length, the $^3/_{16}$-in. steel plate was cut to size, press-formed and joined by depositing $1^1/_2$-in. intermittent welds along the seams. Weld beads were made about 2 in. apart to minimize distortion from heat. One-inch angles were fused around the inside of the structure at the center to add rigidity.

PRODUCTION OF LCM-3 LANDING BARGES

A.-c. arc welding is playing a major part in the fabrication of LCM-3 landing barges at the Trageser Copper Works, Maspeth, L. I. The barges are fabricated from parts made on jigs and fixtures, and practically all of the welding on them is done with 300- and 500-amp. a.-c. arc welders.

Prior to April 1942, when the first contract was received, no one at Trageser had ever seen an LCM-3. The company was unprepared to build one, and the plant was 1000 feet away from water, but three months later the first barge was launched and for some time now production has been many, many times the original goal.

When the first contract was received, the entire plant was torn apart and completely redesigned for the production of LCM-3's. Soon new equipment—including 44 additional a.-c. arc welders—was coming in the front door, and the fabrication of the first barges began even while conversion was still going on.

In the meantime, traveling jigs and fixtures were designed and built for every subassembly; tracks were laid the length of the shop; steel carriages and a 650-ft. concrete roadway were built to carry the barges to the water; and a huge gantry crane was installed at the launching basin.

It was a challenging job, especially because the relative lack of standardized production and procedure data required new planning for almost every operation. But after the first few barges were accepted the blueprints were locked away in the vault, and from then on every part was built on jigs and fixtures.

At Trageser, the barges are turned upside down and built "downward" from the bottom to the top. In this way, construction proceeds from a relatively flat base, which simplifies many of the assembly and welding procedures.

Master jigs accommodate the skeletons of the boats while they are in the inverted position. Eighteen frames, made of junior I beams and channel iron, are first locked into position. Then the battens—long strips of $^1/_4$- x 2-in. mild steel bars—are welded to the frames. Preformed bulkheads, watertight compartments, bottom plates, tunnel assemblies to accommodate the twin propeller shafts and the exterior side plates are next welded into place against the battens.

There, again, Trageser departs from conventional procedure, since in most yards side and bottom plates are precut or "lofted" from patterns to the proper size and shape. Too, slight variations in the size and contour of each boat, often encountered under the most favorable conditions, frequently make it necessary to alter or scrap the precut parts.

At Trageser, however, standard, full-size steel plates are tack-welded to the side and allowed to extend above and beyond the outside limits of the boat. The excess is cut off with a gas torch and welding is then completed. This assures an exact fit and eliminates refitting or scrapping of the parts.

Following this, the barges are turned right side up and mounted on carriages which travel on tracks throughout the length of the shop. Various subassemblies are then welded into place—the all-welded, bullet-proof pilot house, the instrument control board, fuel tanks and coaming. The powerful engines, the propellers and the rudder assemblies are installed. The inside wall plates and the floor plates (equipped with row after row of traction bars to help tanks get off to a charging start) are welded into position.

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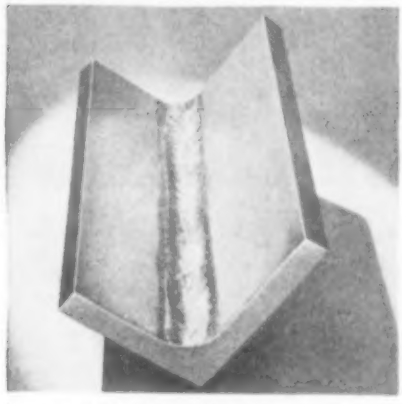
Showing the advantage of position weld - one pass with heavy rod (at left) where two or three passes with a lighter rod would ordinarily be required (at right)



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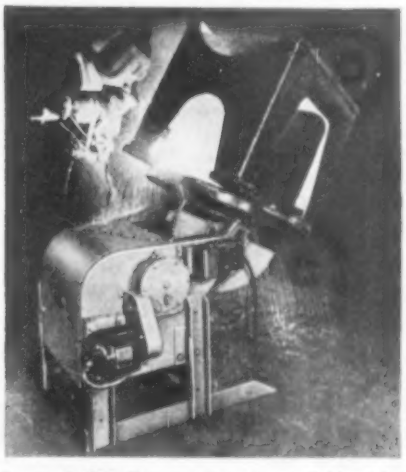

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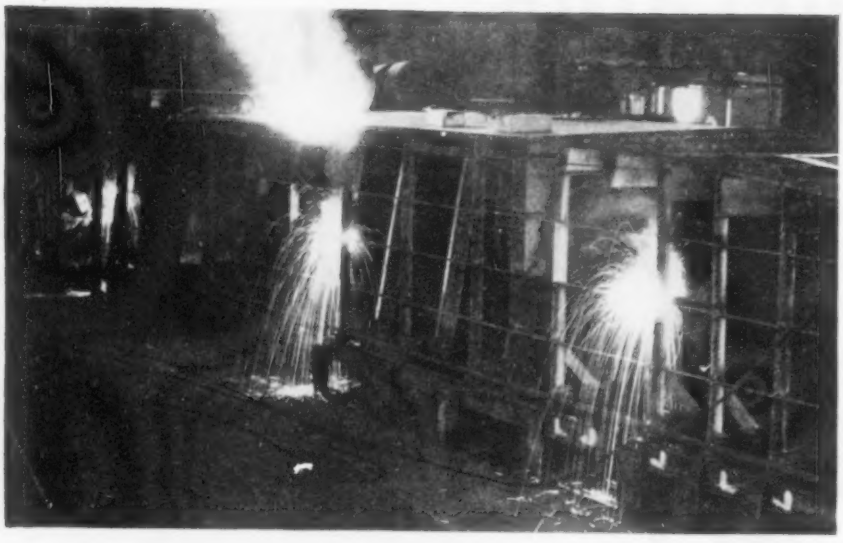

Inverted Landing-Barge Frame Being Fabricated with Arc-Welding Main Jig

Then the heavy ramp forming the bow of the barge is fabricated separately and hooked into place as the nearly finished barge approaches the "dry-launching door," where it starts down the concrete roadway to the launching basin.

According to Fred Scheer, hull-construction foreman, a.-c. welders are almost universally used at Trageser because a.-c. welding, by counteracting arc-blow, enables the operators to weld in every position and location. In addition, these welders are quiet, which is important when a large number of them are in operation. . . The welders have been operating 20 hr. a day, 6 days a week, for over 2 yr. and not one has required maintenance.

All the welding done at Trageser must meet Navy specifications, and a large percentage is done in the vertical and overhead positions, particularly the welding of batten strips to the frame in the main jig.

The Trageser concern has had 90 years' experience in metal working and plate fabrication, and more than 20 years' practical experience with arc welding. In the 1880's Trageser made copper piping and miniature experimental tanks for Simon Lake's submarine, the *Nautilus;* it made storage tanks and range boilers during the Spanish-American war; and it built bomber fuel tanks during World War I.

Completed Landing Barge Being Launched

OBITUARY

A. H. Bond, Proprietor of the Bond Welding Shop, Grand Rapids, Mich., died of a heart ailment on July 12, 1944.

Al, as he was known to his many customers and friends, was 55 years of age. He had been engaged in the welding business for over 25 years, starting immediately after his discharge from the Army following World War I. He is survived by his wife and two daughters. He became a member of the SOCIETY in February of this year.

"FLEET-WELDING" BOOKLET

A method for increasing the speed of welding mild steel called "Fleet-Welding" is described in a 48-page booklet just published by The Lincoln Electric Co., Cleveland, Ohio.

How this latest Lincoln development introduces a technique of arc welding which not only greatly increases the speed of the process over conventional welding methods, but also cuts costs as much as 59%, is described in the booklet. Ways in which "Fleet-Welding" utilizes the benefits of "arc force" to obtain greater penetration and the required weld strength are also brought out.

Some of the important subjects covered in this manual include: using "arc force" to increase welding speed; effect of penetration on welding costs; cost reduction with "Fleet-Welding"; factors affecting production speed and general information for use of procedure tables. It also carries complete information with corrective suggestions on the procedures used for butt welds, fillet and lap welds. Several pages are devoted to the procedures used in welding 18-gage to 10-gage sheet metal with tables giving electrode type and size, electrode polarity, current, arc speed, pounds of electrode per foot of weld and recommended fit-up for butt welds, fillet welds, lap welds, corner welds and edge welds.

In addition to the booklet's 29 photographs and drawings illustrating the "Fleet-Welding" technique, the bulletin carries procedure tables which list plate thickness, electrode size, current, melt-off rate, arc speed, number of passes, feet of joint welded per hour, and pounds of electrode per foot of weld.

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You can weld better with these better electrodes! To test your knowledge of practical stainless steel metallurgy, ask for your free copy of the new booklet, "Things to Know About Welding Stainless Steels."

TRY YOUR HAND AT THESE QUESTIONS ABOUT STAINLESS STEEL

		TRUE	FALSE
7.	Stainless Electrodes which are to be used for welding Stainless Vessels subject to Corrosive action, must be stabilized to prevent Carbide precipitation.	☐	☐
8.	Carbide precipitation does not affect the heat resisting properties of Stainless Steel.	☐	☐
9.	Molybdenum is added to Stainless Steels to increase their sealing resistance at elevated temperatures.	☐	☐
10.	Not all Stainless Steels are classified by metallurgists as "Austenitic."	☐	☐

ANSWERS: 7. False; 8. True; 9. False; 10. True.

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Daley, John P. (B), 5731 Goodyear Homes, Brunswick Ga.

CANADA

Flegg, S. F. (B), Ferro Metal Ltd., 384 Sherbrooke St. W., Montreal, Canada.

CHICAGO

Anderson, Harry (C), 4237 Forrest Ave., Brookfield, Ill.
Scott, Maurice P. (C), 4600 Forest Ave., Downers Grove, Ill.
Walker, Richard W. (C), 4033 S. Scoville Ave., Berwyn, Ill.

CLEVELAND

Goller, George (C), 945 Dresden Rd., Cleveland Hts., Ohio.
Hewett, R. J. (C), Arcrods Corp., Box 394, Station D., Cleveland, Ohio.

COLUMBUS

Block, Norman W. (C), 68½, No. Fifth St., Columbus, Ohio.
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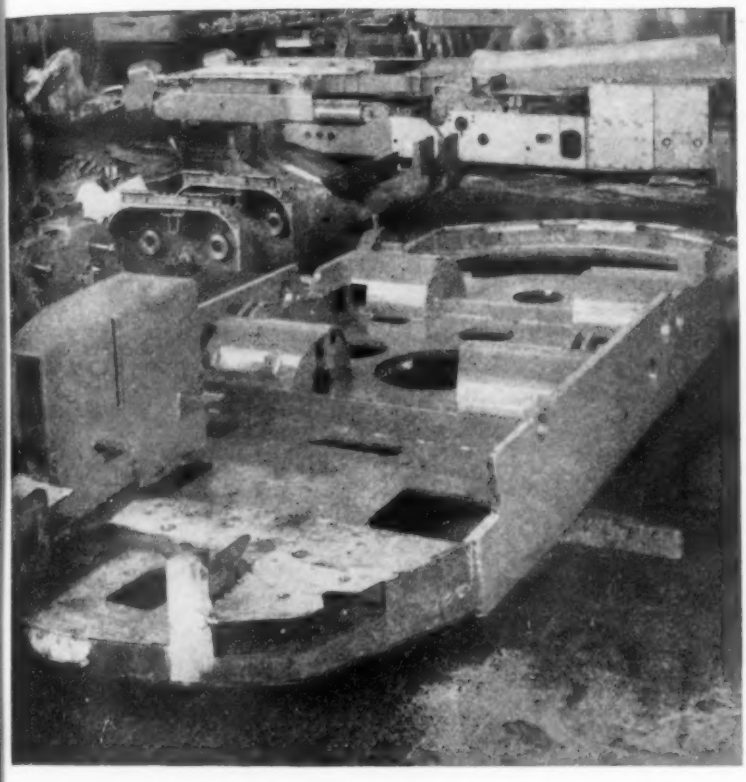

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ELECTRODE FOR LIGHT GAGE METAL WELDING

Airco No. 90-A electrode, an improved version of the smaller sizes of Airco No. 90 electrode has just been introduced by Air Reduction, manufacturers of gas and electric arc-welding and cutting equipment. This electrode is especially designed for welding light gage chrome-moly and similar steels used in aircraft welding. It is made to a completely new coating formula that provides notably smoother arc operation and these other advantages: (1) better appearance of deposits; (2) stronger arc action; (3) reduced slag interference; (4) excellent operation at high currents without deterioration of coating at stub end.

The electrode is available in all three of the most popular sizes for light gage welding—$^{1}/_{16}$, $^{5}/_{64}$ and $^{3}/_{32}$ in. diameters. It is equally efficient for both a.c. and d.c. operation, straight or reversed polarity. Test specimens welded on S.A.E. 4130 with Airco No. 90-A electrode show transverse tensile strengths of 80,000 to 90,000 psi. The electrode meets the requirements of U. S. Army Air Corps Specification 10286-B, Type 1, Grade 2E, and conforms to A.W.S. and A.S.T.M. Specifications for Classification E 6013.

Airco No. 90-A electrode is available through offices of Air Reduction throughout the country. Further details may be obtained by writing to any Airco office, or to the company's main office at 60 E. 42nd St., New York 17, N. Y.

BULLETIN ON WELDING CURRENT HEAT CONTROLS

A technical Bulletin No. WTH-44 containing descriptions, applications, specifications and features of the new improved line of Weltronic "package unit" Heat Controls—which provide dial-controlled infinitely variable phase-shift regulation of welding current—has been released by Weltronic Co., 19500 W. Eight Mile Road, Detroit 19, Mich.

Models are now available for virtually every resistance-welding process including spot, seam, pulsation, butt, flash and forge welding, etc. Models for dual and triple heat controls are essentially combinations of the standard models and provide accurate preselective current adjustment for two or more welding operations performed with the same machine or gun.

Stock models being manufactured are listed in the bulletin, together with explanations of the applications of these control units to single point, multiple point, pulsation and automatic heat rise welding. Also included is a list of major features available such as quick warming type tubes (eliminate warm-up delays); infinitely variable adjustments rendering unnecessary the use of "too hot" and "too cold" transformer taps; safety devices; and the electronic precision control.

Detailed specifications are given together with photographs of various models.

WELDING GOGGLE

A new, improved AO Duraweld welding goggle which provides better protection and greater comfort for welders' eyes is announced by American Optical Co., Southbridge, Mass.

Newly designed eyecups, anatomically molded for the right and left eye, have larger, more comfortable edges, rounded to fit flush against the contour of the face. The eyecups are also shallow but with deep sides, constituting the best balance obtainable between proper height for wider vision and adequate protection. Improved nasal fitting also adds to comfort and safety.

Side shields of entirely new design provide greatly increased ventilation to keep eyes cool and to help prevent the fogging of lenses. The new style louvers are so designed that it is impossible for stray light rays or sparks to reach the eyes.

Easily adjusted, the nonslip, one-piece headband resists perspiration, oil, water, grease. The ball-chain bridge, covered with curved plastic tubing which fits snugly over the bridge of the nose, can be quickly and easily adjusted.

As standard equipment, the new, improved AO 404A Duraweld goggles are fitted with Noviweld lenses in 3, 4, 5, 6 or 8 shades. Optional equipment includes Filterweld lenses in 3, 4, 5, 6, 7 or 8 shades, Noviweld-Didymium lenses, for absorbing yellow sodium flare, in shades 3, 4, 5 or 6, or Super Armorplate Calobar lenses of medium, dark or extra dark shades for persons working near welding operations.

WELD CLEANING TOOL

Combining wire bristle brush and slag removing head in one unit, the Atlas Model A Dual-Tool is an improved weld cleaning tool for welders in shipyards, aircraft, tank plants, boiler and sheet metal shops and for oil pipe line, factory maintenance and general welding work. Tool features an improved brush holder which permits removal of brush for reversing or replacement by inserting screwdriver at rear end of holder. Up and outward pry releases tension. Brush pops out. Reverse action for inserting and brush snaps into a firm, rigid seat. Flex-O type spring steel handgrip permanently welded to handle eliminates possibility of loosening or breaking. Chipping head is hand-forged tool steel.

Every part of this tool is replaceable, including cone and chisel heads.

Made by Atlas Welding Accessories Co., 14824 Wyoming Ave., Detroit 21, Mich.

CIRCUIT CONTROL PANEL

Air Reduction, manufacturer of welding equipment and supplies, has just placed on the market a new and improved circuit control panel for tack welding with a constant potential power supply.

Known as the "Wilson Type 30 Special Tack Welding Circuit Control Panel," it is of simple design, sturdily constructed and very compact.

The resistors of round nichrome wire are mounted on insulators and are designed well within the permitted temperature rise. The housing has sheet metal sides with expanded metal top and bottom to provide for full circulation of air. The mounting brackets are so arranged that panels can be mounted side by side or one on top of another without restricting circulation. The brackets also provide a convenient means of carrying the panels when they are not used at fixed locations.

Current values are controlled by specially designed contacts and are adjusted

RESISTANCE *WELD IT!*

LESSONS learned in exacting war equipment today will play a big part in helping you produce a better, sturdier, more inexpensive product tomorrow. High on the list are the lessons learned in applying resistance welding to new applications and in expanding its usefulness and economy on the more conventional jobs. From fine watch parts to truck axles; from washing machines to giant metal assemblies of all kinds, resistance welding holds new and greater opportunities than ever before. This is especially true when products are designed to take full advantage of the inherent speed and saving of modern resistance welding methods. Dissimilar metals such as copper and tungsten can now be resistance welded successfully.

Whatever your problem — if it deals with the joining of metals — you owe it to yourself to investigate the full possibilities of the most advanced resistance welding methods. The progress has been tremendous. The potentialities for almost any type of metal fabrication are unlimited.

To help solve your present problems and to aid in plans for the future, the members of Resistance Welder Manufacturers' Association will gladly be of any possible service.

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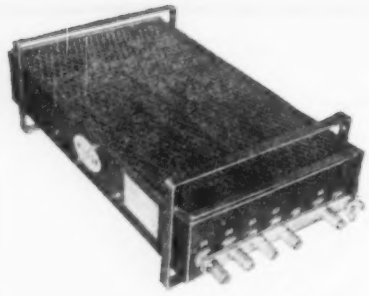

by turning fiber handles tight against a copper bus bar to connect the various resistors into the circuit, output current being the sum of the resistors so connected. Resistors are disconnected by turning the handles in the opposite direction and locking them in position.

Panels are available in 150- and 230-amp. sizes. The former has taps for 10, 20, 40 and 80 amp. and the latter has taps for 10, 20, 40, 60 and 80 amp. Current adjustment on both units is possible in 10-amp. steps.

The panel is designed so that calibration figures marked on the panels are correct when connected to a 55-v. generator with 25 v. arc and 5 v. drop in the welding head. The drop in the panel is 35 v. at rated current values.

A recently issued bulletin describing and giving complete technical data on the new Wilson Type 30 Tack Welding Circuit Control Panel may be had by writing Air Reduction, 60 E. 42nd St., New York 17, N. Y., or any Air Reduction Sales Office.

WEST COAST TO SEND LARGE DELEGATION TO METAL CONGRESS

Coming out of the West will be an influential delegation to the 26th Annual National Metal Congress and War Conference Displays to be held the week of October 16th in Cleveland's Public Hall.

Typical of the aggressive spirit of the Far West, the Los Angeles Chamber of Commerce and the State of Washington will merchandise the industrial advantages of their areas to the metal industry in specially prepared exhibits. These organizations will come to the heart of the metal industry with a story of the industrial advantages of the west coast.

Included in this West coast delegation to the Congress will be the exhibits of such companies as the Robert H. Clark Co., Crozier Machine Tool Co., Machinery Manufacturing Co., Diamond Tool Co., and Western Metals, all of the Los Angeles, and Nelson Specialty Welding Equipment Corp. of San Leandro.

Basing his estimates on this widespread interest in the October meeting and on the experience of former years, W. H. Eisenman, managing director of the Metal Congress expects an attendance in excess of 35,000 persons. As evidence of the scope of the displays, Eisenman says 168,000 sq. ft. of exhibit space have been reserved for nearly 325 displays offering many new ideas in war and peace production facilities.

Another big feature of the Congress will be the technical sessions of five national societies meeting in conjunction with the Conference Displays. More than 150 technical developments arranged by some 1000 metal experts will be presented during morning, afternoon and evening sessions. In addition to the American Society for Metals, sponsor of the meeting, other cooperating societies are the AMERICAN WELDING SOCIETY, the Iron and Steel and Metals divisions of the American Institute of Mining and Metallurgical Engineers, the Society for Experimental Stress Analysis and the American Industrial Radium and X-Ray Society.

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Farrel-Birmingham Company, Inc., with plants in Ansonia and Derby, Conn. and Buffalo, N. Y., is a leading manufacturer of heavy machinery for the rubber, plastics, metals, sugar and paper industries, and manufactures gears and gear drives for all industrial and marine applications. During the war a major proportion of its facilities has been devoted to producing marine drives for Navy and Maritime Commission ships.

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Soldering. Factors Affecting Strength on Soldered Joints Made from Electro-Tinned Steel Sheet, A. W. Hothersall, D. W. Hopkins and G. L. Evans. Iron & Steel, vol. 17, no. 10 (May 18, 1944), pp. 448–450.

Steel Fatigue. Metallurgical Notch as Factor in Fatigue Failure, W. H. Bruckner. Metal Progress, vol. 45, no. 6 (June 1944), pp. 1102–1103.

Obvious Quality

VISUAL

Clean cut mechanical nicety literally radiates from these UNITED mercury rectifiers. It is only natural that their eye appeal impresses the exacting minds of so many government and commercial engineers.

TEST

The physical ruggedness and sterling workmanship in these tubes reveal the kind of care and precision that has entered into the electrical phases of their design. They are criterions, rather than ordinary conformers to the constantly stiffening Army and Navy test specifications—*both* mechanical and electrical.

SERVICE RECORDS

Representative service records maintained over a period of 10 years by large users prove an average of many thousands of hours satisfactory operating life.

THERE IS NO SPECULATION IN CHOOSING UNITED MERCURY RECTIFIERS

UNITED
MERCURY RECTIFIERS

UNITED ELECTRONICS COMPANY • NEWARK 2, N. J.

Transmitting tubes exclusively since 1934

The UNITED types illustrated will interchange with and replace other type tubes as follows:

USE UNITED TYPE	967	to replace	FG-17
" " "	972-A	" "	872-A
" " "	UX-973		—
" " "	973 (Not illustrated)		873

SECTION ACTIVITIES

CLEVELAND

Officers elected for the 1944–45 season have been Ross J. Yarrow, Republic Iron Works, *Chairman;* John Ridenour, Standard Oil Co, *Vice-Chairman;* A. Leslie Pfeil, Universal Power Corp., *Secretary-Treasurer.*

Programs have already been planned and speakers arranged for the new season, which promises to be one of the best in many years.

For several years the Cleveland Section has had what they call a Building Code Committee, whose main function was to influence the City Building Commission to include welding provisions in the city's code. Welding is allowed in buildings in Cleveland only by special permit and the Building Commission has not been interested in incorporating welding specifications in the code. Stirrings of life in the Commission this year indicate, however, that several years of effort may come to fruition.

The Cleveland Section looks forward to welcoming members from all other sections to the Annual Meeting in October.

DETROIT

The Executive Committee of the Detroit Section held a meeting on June 2nd in the Rackham Memorial Building to appoint committees to carry on the business of the Section for the coming year and also to select the types of meetings to be given and the places where they are to be held.

The first business of the evening was the appointment of A. J. Last as Assistant Secretary.

The following committees were then appointed.

Membership: H. C. Neitzel, *Chairman;* F. P. Iapolucci, J. Hassler, K. Sheren, W. R. Stickney, K. Keck, V. Chisholm, F. G. DaRoza, E. Courtemanche, J. Graham.

Publicity: S. Brams, *The Iron Age.*

Vocational Guidance: A. H. Lewis, H. Jorsted.

Patrons: C. E. Phillips, C. E Phillips & Co.

Programs: J. M. Diebold and A. J. Last.

Reception: E. Brown, *Chairman;* R. Baker, M. R. Scott, L. W. Clark, M. J. Bartch, M. G. Gaskin, A. E. Lofquist, C. J. Collum.

Entertainment of Speakers: G. W. Sloan, *Chairman;* W. H. Simmons, G. J. Freibel, M. R. Scott, G. J. Dekker.

Affiliate Council: D. H. Corey, *Chairman;* Leo A. Eckerman.

Entertainment: Keith Sheren, *Chairman;* J. Johnston, J. Hassler.

It was voted that five meetings would be held at the Rackham Memorial Building and four elsewhere.

LOUISVILLE

The social activities of the Louisville Section were augmented Sunday, July 30th, by an all-day outing in the banks of the beautiful Ohio. The Mid-Summer Stag Fish-Fry was the occasion. One hundred fifty jovial guests made up a combination to be characterized as a "Perfect Day."

Some 30 valuable prizes were given away. These appropriate gifts were donated by individuals and parent organizations and ranged from useful welding paraphernalia to War Bonds.

This so called "Fish-Fry" was really misnamed as the guests found out when facing a real Super-Dinner-DeLuxe out door style. In summing up this very successful affair, credit is given to the Section Chairman, T. H. Lewis, who arranged the details for this long-to-be-remembered occasion.

G. N. Sieger, General Manager of S.M.S. Corporation, Detroit, has accepted an invitation to speak at the September 26th meeting of the Louisville Section, on "Resistance Welding."

NORTHERN NEW YORK

The Executive Committee of the Northern New York Section held a meeting on Thursday, July 20th, at the Schenectady Y.W.C.A.

The following committee chairmen were appointed.

Meetings and Papers: R. W. Clark.

Public Relations: W. F. Hess.

Education: M. F. Sayre.

*Coordinating:** E. R. Spittler and H. S. Swan.

Membership: C. D. Todd.

Nominating: C. I. MacGuffie.

Publicity and Arrangements: E. R. Spittler.

* Representatives on the Schenectady Engineering Council.

PUGET SOUND

Prof. Gilbert Schaller of the University of Washington spoke on "Technical Evaluation of Welding," at the June 13th meeting of the Puget Sound Section, held at the Gowman Hotel, Seattle. Prof. Schaller treated the subject of welding inspection from mathematical angle trying to develop the idea of predictable failure in welding by studying a number of weldments and keeping a record of percentage of failures or poor welding. Prof. Schaller's address was very well received by the 40 who attended both the dinner and the meeting.

SAN FRANCISCO

The May meeting of the San Francisco Section was held at El Jardin Restaurant, San Francisco. There were approximately 55 members and guests present.

The meeting was addressed by H. W. Saunders of the Air Reduction Sales Co. Mr. Saunders' talk was graphically illustrated by lantern slides depicting the part which the Compressed Gas Industries have played and are playing in our efforts toward ultimate and complete victory.

The meeting was then addressed by H. A. Folgner, of Handy and Harman. Mr. Folgner's talk, which was also accompanied by lantern slides, showed the multitude of applications of silver brazing, both in the war effort and in civilian industries.

SYRACUSE

Engineering, Science and Management War Training Courses under the supervision of Syracuse University, are announced for the Summer and Fall of 1944. No tuition or other fees are charged, since the program is sponsored by the U. S. Office of Education. However, students are required to purchase textbooks and such miscellaneous material as may be required in connection with their studies.

The Welding Engineering course is given in two sessions weekly, 7:30–9:30 P.M. for 16 weeks. The course contains the elements of physical metallurgy; welding design, processes and materials; joint preparation and heat treating; prevention of defects; inspection and testing; qualifications for welders; welding codes; welding of alloys and nonferrous metals; jigs and fixtures; resistance welding; costs; and safety precautions.

Qualifications for admission to the course are graduation from a recognized four-year high-school program that has included college entrance subjects or equivalent; employment in war work in which this training will be useful.

A form for making application for admission may be obtained from the Personnel Departments of local industries or from the ESMWT, College of Applied Science, Syracuse University.

WICHITA

A business meeting of the Wichita Section was held on July 14th in the Rainbow Room of the Coleman Lamp & Stove Co.

The following appointments to the Executive Committee were made.

Program Committee: E. A. Bussard, *Chairman.*

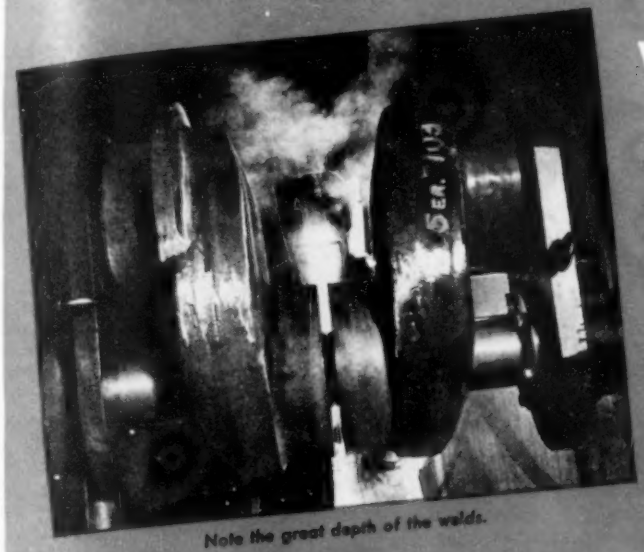
Membership Committee: M. A. Barrett, *Chairman.*

Housing and Greeters Committee: J. T. Phillips, *Chairman.*

Publicity and Equipment Committee: Don M. Clark, *Chairman.*

Entertainment Committee: Alvis W. Covert, *Chairman.*

Is This the Most Critical Welding Job?



Note the great depth of the welds.

Two of the forgings from which the shaft was built up.

SMITHway Electrodes in Action . . . *sixteen forgings were welded together with SMITHway Certified Electrodes to make this 15⅜-in. diameter, 28-ft. Diesel engine crankshaft . . . one of a number produced by A. O. Smith.*

ARC welding a 15⅜"-diameter crankshaft from sixteen forgings is difficult. The welds are deep. *Good* welds are a *must,* because the shaft is subjected to terrific vibratory stresses, and because the consequences of failure are grave.

A few years ago, the job couldn't have been done. Now A. O. Smith is doing it . . . with especially developed electrodes and techniques.

We can't buy electrodes which meet our exacting requirements for this and other critical jobs. So we make our own. We *know* that these SMITHway Certified Electrodes are uniformly good, because we use 320,000 of them per day in commercial production.

We offer you the same electrodes. They've speeded work, cut costs, and licked the toughest jobs for us. Let them demonstrate that they can do the same for you.

Mild Steel . . . High Tensile . . . and Stainless Steel

WELDING ELECTRODES

made by welders . . . for welders

Have You Bought That Extra War Bond This Month?

SMITHway A. C. Welding Machine saves power; eliminates arc blow.

SMITHway Welding Monitor trains better welders faster.

A. O. SMITH Corporation

MILWAUKEE · WISCONSIN · HOUSTON · TEXAS

Offices at: NEW YORK, PITTSBURGH, CHICAGO, TULSA, HOUSTON, LOS ANGELES, SEATTLE

In Canada—JOHN INGLIS CO., LIMITED

Attendance Committee: Trent Hunt, *Chairman.*

Safety Committee: Roy A. Coonfield, *Chairman.*

YORK-CENTRAL PENNSYLVANIA

The following is the schedule of meetings for the York-Central Pa. Section starting with the October meeting.

Oct. 11, 1944—Speaker: W. F. Grunow, Welding Engineer, Allegheny Ludlum Steel Corp. Subject: Welding of Stainless and Stainless-Clad Steels, Motion Picture of Stainless-Clad Steel Uses.

Nov. 10, 1944—Speaker: L. S. Blumberg, Metallurgist, The M. W. Kellogg Co. Subject: Steels for Future Welded Construction, Welding Fundamentals and Metallurgy.

Dec. 13, 1944—Speaker: E. B. Van Sant, Supt., Badenhausen Corp. Subject: Welding for High Pressures, Moving Picture of Modern Boiler Operations.

Jan. 10, 1945—Speaker: Forrest Waldo, Applied Eng. Dept., Air Reduction Sales Co. Subject: Gas Cutting Applications, Latest Developments and Uses.

Febr. 14, 1945—Speaker: T. M. Jackson, Electrical Engineer, Sun Shipbuilding & Dry Dock Co. Subject: Welded Ship Construction, Future Place of Welding in This Industry.

March 14, 1945—Speaker: E. J. Charlton, Asst. to President, Lukenweld, Inc. Subject: Conversion to Welded Steel, Welded Steel Products Development.

April 10, 1945—Annual Dinner, General Electric Co. Subject: "House of Magic."

May 9, 1945—York-Coatesville Meeting, Lukens Steel Co., Coatesville, Pa.

Employment Service Bulletin

POSITION VACANT

V-146. Young man with engineering training and experience for employment with engineering organization engaged in development work in the welding field. Knowledge of metallurgy desirable. For interview, write stating age, education, experience and draft status.

V-147. Welding Engineer with a good working knowledge of arc-welding processes, particularly automatic welding. A knowledge of submerged arc welding would be extremely helpful. The position also requires executive ability, organizing ability and a knowledge of the requirements of machine and fixture design. Man who is capable of coordinating the activities of various groups working on the application of automatic arc-welding processes and the design and purchase of equipment for welding operations in production.

SERVICES AVAILABLE

A-481. Responsible chemist-metallurgist widely experienced in welding desires customer contact position with growing concern with postwar possibilities. Available now.

A-482. Welding Superintendent desires position. Currently employed on U. S. Navy contracts. Twenty years' experience, including charge of all pipeline welding for large public service corporation; instructor of welding at leading schools. Thirty-six years of age, married, three children. Can furnish references.

COMING EVENTS

October 16–20—National Metal Congress, National Metal Exposition, Public Auditorium, Cleveland, Ohio. Mr. W. H. Eisenman, Director, 7301 Euclid Ave., Cleveland, Ohio.

October 16–20—American Society for Metals, Annual Meeting, Cleveland, Ohio. Mr. W. H. Eisenman, Secretary, 7301 Euclid Ave., Cleveland, Ohio.

October 16–19—American Welding Society, Annual Meeting, Cleveland, Ohio. Miss. M. M. Kelly, Secretary, 33 W. 39th St., New York Ci y.

October 17–20—Society for Experimental Stress Analysis, Semi-Annual Meeting, Cleveland, Ohio. Dr. W. M. Murray, President, P. O. Box 168, Cambridge 39, Mass.

October 16–18—Iron & Steel Division and Institute of Metals Division, American Institute of Mining & Metallurgical Engineers, Fall Meeting, Cleveland, Ohio. Mr. Frank T. Sisco, Division Secretary, 29 W. 39th St., New York City.

October 18–20—American Industrial Radium and X-Ray Society, Annual Meeting, Cleveland, Ohio. Mr. Philip D. Johnson, Secretary, Room 1612, 25 E. Washington St., Chicago 2, Ill.

CAPACITOR DISCHARGE CONTROLS FOR RESISTANCE-WELDING MACHINES

A new precise electronic forge-pressure timer has been incorporated in the G-E line of capacity discharge controls for use with stored-energy type resistance-welding machines, it has been announced by the Industrial Control Division of the General Electric Co. The new timer, which is designed for dual-pressure spot-welding machines of the capacitor discharge type, functions to supply accurately timed forge pressure, so that the required welding energy, cracks, indentations and sheet separation are reduced.

Calibrated in milliseconds, the timer consists of a timing circuit with a regulated d.-c. source of voltage to assure accurate timing; the necessary electronic tubes; and a time-delay relay with fixed timing for compensating for the delay in the operation of the solenoid valve on the welding machine, so that the forge pressure can be applied precisely at any point during the current discharge.

A feature of the new timer is that it is mounted on a small steel base so constructed that it can be added to any G-E capacity discharge control already installed, providing the resistance-welding machine has a dual-pressure system designed for this purpose.

BURDETT OXYGEN BUYS AMERICAN INDUSTRIAL SAFETY EQUIPMENT CO.

The recent purchase of The American Industrial Safety Equipment Co., Brooklyn, N. Y., by The Burdett Oxygen Co., Cleveland, Ohio, has aroused a considerable amount of favorable comment among those aware of the move. Official announcement of the transaction has just been made by Mr. William H. Loveman, president of the latter concern.

The Burdett Oxygen Co. has, in the past 20 years, become one of the foremost suppliers of all welding and cutting equipment, as well as oxygen, acetylene and other gases. By the acquisition of American Industrial Safety Equipment, they will expand these lines to cover a wide selection of goggles, spectacles and lenses for industrial use; all styles of welding helmets and hand shields; rubber, leather and asbestos work gloves; face shields, respirators and other related items.

According to Mr. Loveman's statement, American Industrial will continue the manufacture and sale of the above items, operating as a division of The Burdett Oxygen Co. Production and distribution will be retained at the American Industrial plant, 397 Bridge St., Brooklyn N. Y. General executive work and policies, however, will be controlled and determined at the main offices of The Burdett Oxygen Co., 3300 Lakeside Ave., Cleveland, Ohio.

A new catalog is now being printed, which will list and describe the complete line of products offered by The American Industrial Safety Equipment Co. This catalog will soon be available for widespread distribution.

SEAMLESS TUBE DATA BOOK

This new book on tubing is divided into four principal sections, with guide index, covering General Data, Mechanical Tubing, Pressure Tubing, and Reference Tables.

Under General Data, there is a brief summary on the history, manufacture, tests, special shapes and standard steels with chemical composition, mill practices, etc.

The section on Mechanical Tubing covers information on typical uses, suggestions of how to obtain best results through the use of tubing, determining proper size, with complete tolerance tables, properties for beams, and a digest of standard specifications.

The section on Pressure Tubing covers various pressure formulas, specifications and tolerance tables for boiler tubes, heat exchanger and condenser tubing, still tubes, alloy steel pipe, stainless steel analyses, with metallurgical data.

The Reference Table section is unusually extensive with many formulas, weight tables for rounds, squares, rectangles, surface areas both inside and outside, and other tables commonly found useful in tubing applications.

The book is issued by Seamless Steel Tube Institute, Pittsburgh 19, Pa., 320 pages, loose-leaf binder, 8½ x 11 in. Price $2.50.

THE METAL INDUSTRY AND ITS FUTURE

Design for Tomorrow

ATTEND THIS YEAR'S METAL CONGRESS
OCTOBER 16-20 IN CLEVELAND

In Cleveland's big Public Hall this October 16th, the metal industry will meet to take stock of its present tremendous fund of information during the 26th annual National Metal Congress and War Conference Display.

To knit together these developments of the war years as a compact design for tomorrow, some 30,000 metal men will attend this five-day meeting. They will see more than 300 exhibits devoted to new improvements in metals, processes, products and equipment.

They will hear more than 150 technical and practical lectures prepared by nearly a thousand metal experts under the direction of five great national societies. This is the metal industry's 26th annual postgraduate course on metals, with the emphasis this year on the design for tomorrow.

You are cordially invited to attend.

Your only entrance fee will be your interest in metals. Pack your problems — come prepared to partake of the expert knowledge available — to participate in wide-open technical sessions. Come prepared to see scores of operating exhibits and to discuss what's new with the engineering experts of more than 300 companies.

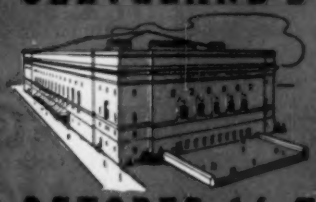
Make your hotel reservations now through the Housing Bureau, c/o Cleveland Convention & Visitors Board, 1604 Terminal Tower, Cleveland 13, Ohio.

For Exhibit Space

Certain choice display spaces are still available even though 300 companies have already reserved space. For complete information on displays, wire collect to American Society for Metals, 7301 Euclid Avenue, Cleveland 3, Ohio.

NATIONAL METAL CONGRESS

CLEVELAND'S



Public Hall

OCTOBER 16 THRU 20, 1944

AND WAR CONFERENCE DISPLAY

Sponsored by the American Society for Metals, in cooperation with the American Welding Society, the Iron and Steel and Institute of Metals divisions of the American Institute of Mining and Metallurgical Engineers, the American Industrial Radium and X-Ray Society and the Society for Experimental Stress Analysis.

TENTATIVE PROGRAM

TWENTY-FIFTH ANNUAL MEETING AMERICAN WELDING SOCIETY OCTOBER 16–19, 1944

HOTEL CLEVELAND, CLEVELAND, OHIO

MONDAY, OCTOBER 16th, Morning—9:30 A.M.

OPENING SESSION

Chairman—DAVID ARNOTT
President, American Welding Society

Vice-Chairman—E. V. DAVID
Chairman, Convention Committee

PRESENTATION OF MEDALS AND PRIZES

WELDING AIDS THE WAR EFFORT

Welding as an Aid in Shipbuilding Construction, by ADMIRAL H. L. VICKERY, U. S. Maritime Commission

Welding as an Aid in the Fabrication of Ordnance Equipment, by COL. S. B. RITCHIE, Office, Chief of Ordnance

Welding in Aircraft Construction, by W. B. STOUT, Consolidated Vultee Aircraft Corp.

Monday Afternoon—2:00 P.M.

THREE SIMULTANEOUS SESSIONS

WELDING AND CUTTING IN HEAVY INDUSTRIES

Chairman—R. J. YARROW,
Republic Structural Iron Works

Vice-Chairman—J. M. DRISCOLL,
Air Reduction Sales Co.

Fundamentals of Heavy Cutting
by G. L. WALKER and H. G. HUGHEY, Air Reduction Sales Co.

Fabrication and Reclamation in Steel Mill Maintenance
by E. W. GRUBER, Wheeling Steel Corp.

Unusual Applications of Gas Cutting in Ordnance Fabrication
by C. M. UNDERWOOD, Northern Ordnance, Inc.

Procedure Control of Automatic Welding Processes
by A. E. BEDELL & J. B. QUIGLEY, Graver Tank & Mfg. Co. Inc.

RAILROAD AND TRANSPORTATION

Chairman—J. W. SHEFFER,
American Car and Foundry Co.

Vice-Chairman—A. G. OEHLER,
Associate Editor, Railway Age

Welding of Aluminum Tank Cars
by A. H. WOOLLEN, Railroad Sales, Aluminum Co. of America

Welding for Main Line Operation
by O. K. KJOLSETH, Locomotive Eng. Div., General Electric Co

Railroad Welding
by JOHN McMULLEN, Erie Railroad Company

WELDABILITY

Chairman—A. B. KINZEL,
Union Carbide & Carbon Corp.

Vice-Chairman—C. H. JENNINGS,
Westinghouse Electric & Mfg. Co.

Welding of Manganese Steels
by W. B. BROOKS and A. G. WAGGONER, Cramp Shipbuilding Co.

High Tensile Manganese Silicon Steels for Welded Fabrication
by G. G. LUTHER and F. H. LAXAR, Naval Research Lab.

The Bead-Weld Nick-Bend Test for Ductility
by C. E. JACKSON and G. G. LUTHER, Naval Research Lab.

The Influence of Minor Variables of Weldability
by R. D. STOUT, S. S. TÖR and G. E. DOAN, Lehigh University

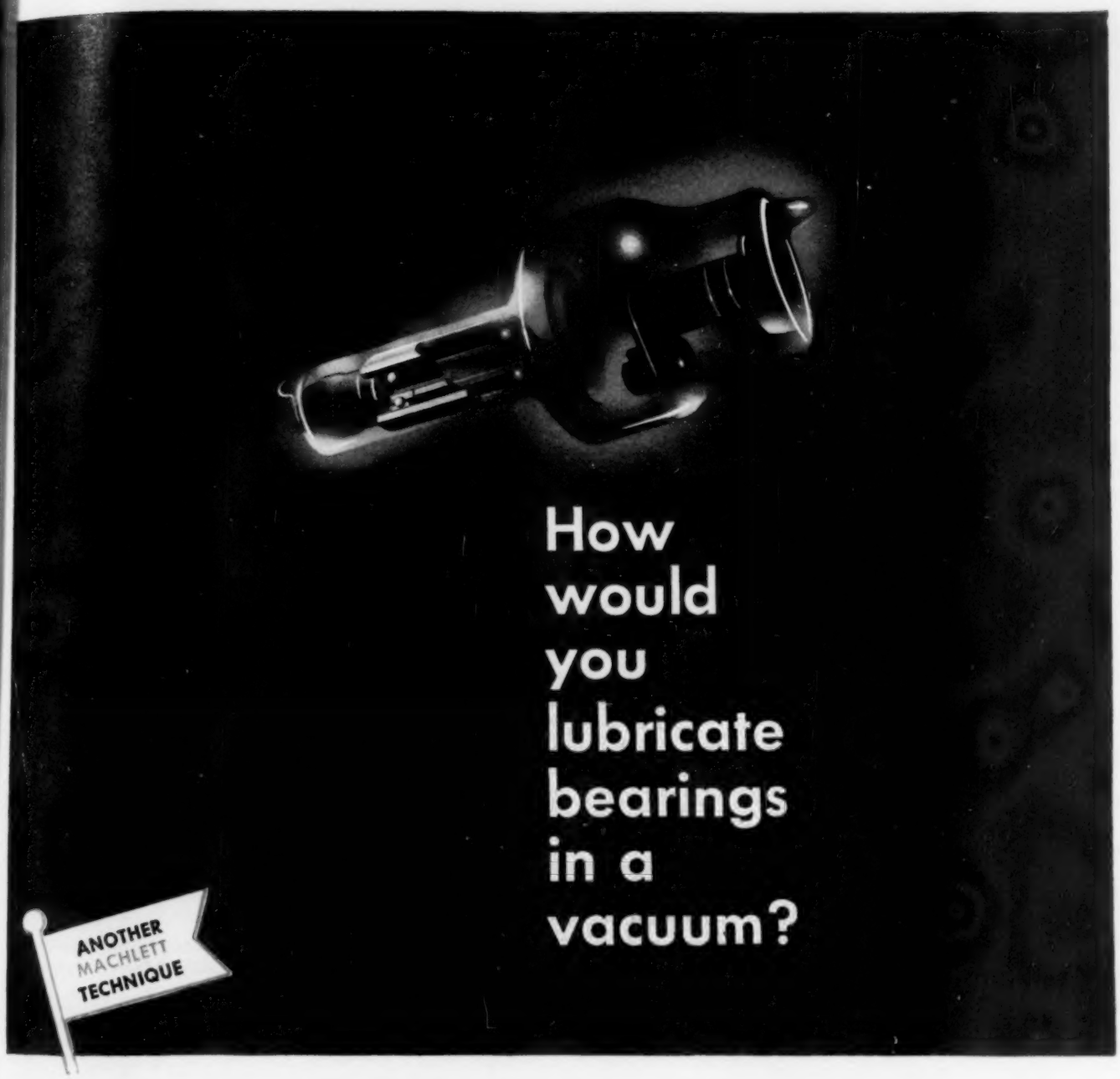
Monday Evening—8:00 P.M.

ADAMS' LECTURE

Chairman—WENDELL F. HESS,
Rensselaer Polytechnic Institute

Vice-Chairman—R. H. ABORN,
United States Steel Corp.

Solid Phase Welding by DR. A. B. KINZEL, Union Carbide and Carbon Corp.

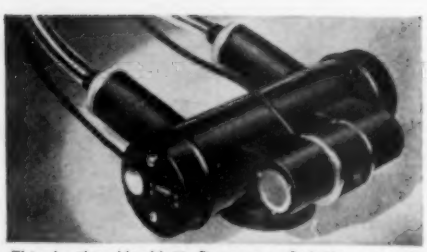


This is a cross-section of the Machlett Dynamax X-ray tube. The ball bearings support the anode, which rotates at 3000 r.p.m., and reaches a temperature of 1000° F. The entire structure is in a vacuum of about 10^{-6} mm. of mercury, or a billionth of an atmosphere.

Conventional lubricants cannot be used, because they would destroy the vacuum and the tube. Machlett's scientific studies showed that a very thin film of certain metals can act as lubricant. Pure silver was found most advantageous. An almost molecular-thin film of it is deposited upon the balls in a vacuum, by a unique method.

So successful was this technique that Machlett, five years ago, guaranteed its Dynamax rotating anode tube for 10,000 exposures. Today it outlasts conventional stationary anode tubes. Some amazing records have been made with it, the best to date being 272,610 exposures, at the Army Examining and Induction Station, Pittsburgh, Pa.

This tube has a focal spot so small as to produce exceedingly sharp pictures, and an X-ray beam so intense as to make possible exposures as short as 1/60th sec. It was the solution of the lubrication problem that added reliability to these advantages. Machlett employs many other advanced techniques in the manufacture of its various types of high-vacuum tubes for medical, scientific and industrial purposes . . . Machlett Laboratories, Inc., Springdale, Connecticut.



This is the Machlett Dynamax Rotating Anode tube, 100 kilovolts, 50 kilowatts, as supplied in an oil-filled, shockproof housing with air circulator and vapor-proof cable terminals.

MACHLETT

X-RAY TUBES SINCE 1898

TODAY THEIR LARGEST MAKER

TUESDAY, OCTOBER 17th, Morning—9:30 A.M.
THREE SIMULTANEOUS SESSIONS

RESISTANCE WELDING

Chairman—L. C. BIBBER, Carnegie-Illinois Steel Corp.

Vice-Chairman—G. N. SIEGER, S.M.S. Corp.

Spot Welding Machines for Heavy Gauges of Ferrous and Non-Ferrous Metals
by MARIO SCIAKY, Sciaky Bros.

Heat Transfer Across Contact Surfaces
by W. B. KOUWENHOVEN, Dean, School of Engineering, Johns Hopkins University

Problems in Spot Welding Heavy Mild Steel Plate
by F. R. HENSEL, E. I. LARSEN and E. F. HOLT, P. R. Mallory & Co., Inc.

RESEARCH

Chairman—S. L. HOYT, Battelle Memorial Institute

Vice-Chairman—R. E. KINKEAD, Consulting Welding Engineer

The Effect of Postheating in Welding Medium Alloy Steels
by M. A. PUGACZ and G. J. SIEGEL, Naval Research Laboratory

Stress Relieving Study
by PROF. J. R. STITT, Ohio State University

The Effects of Metallurgical Changes Due to Heat Treatment Upon the Fatigue Strength of Carbon-Steel Plates
by W. H. BRUCKNER and W. H. MUNSE, University of Illinois

STRUCTURAL

Chairman—A. S. LOW, The Austin Co.

Vice-Chairman—J. F. MAINE, Republic Structural Iron Works

Standard Details for Welded Building Construction
by H. W. LAWSON, Bethlehem Steel Co.

Field Welded Pressure and Variable Volume Storage Tanks
by FRED L. PLUMMER, Hammond Iron Works

Welding Railroad Structures
by T. H. GARDNER, Florida East Coast Ry.

Tuesday Afternoon—2:00 P.M.
THREE SIMULTANEOUS SESSIONS

RESISTANCE WELDING

Chairman—R. E. POWELL, Western Electric Co.

Vice-Chairman—H. C. COGAN, National Electric Welding Machines Co.

Low Reactance Cable for Portable Resistance Welders
by MYRON ZUCKER, Mackworth G. Rees, Inc.

The Flash-Butt Welding of Alloy Steels
***(a)* Welding Variables**
by J. J. RILEY, Taylor-Winfield Corp.
***(b)* Metallurgical and Physical Characteristics**
by J. C. BARRETT, Taylor-Winfield Corp.

Small Portable Condenser Welding Set
by E. M. CALLENDER, E. G. Budd Mfg. Co.

RESEARCH

Chairman—H. C. BOARDMAN, Chicago Bridge & Iron Co.

Vice-Chairman—G. V. SLOTTMAN, Air Reduction Sales Co.

Some Recent Developments in Stainless Steel Welding
by D. L. MATHIAS, Metal & Thermit Corp.

Bi-axial Fatigue Strength of Low-Carbon Steels
by GEORGE K. MORIKAWA and LeVAN GRIFFIS, Illinois Institute of Technology

Weldability Tests of Cast Steel
by C. E. JACKSON and F. S. McKENNA, Naval Research Lab.

Weldability-as-Rolled vs. Heat-Treat High Strength Constructional Steels
by Lt. S. A. HERRES and W. L. WARNER, Watertown Arsenal.

SHIPS

Chairman—J. L. WILSON, American Bureau of Shipping

Vice-Chairman—S. A. MIDNIGHT, American Ship Building Co.

Controls Required for Safe and Economical Construction of Welded Ships
by D. G. MAXSON, Welding Consultant, Marinship Corp.

Technical Control of Welding in Ship Construction
by M. H. MacKUSICK, California Shipbuilding Corp.

Evolution of Welding in Shipbuilding
by M. N. MALTSEFF, Western Pipe and Steel Co.

Multiple and Stack Machine Cutting
by A. H. YOCH, Air Reduction Sales Co

Tuesday Evening—8:00 P.M.
UNIVERSITY RESEARCH CONFERENCE

WEDNESDAY, OCTOBER 18th, Morning—9:30 A.M.
TWO SIMULTANEOUS SESSIONS

AIRCRAFT

Chairman—G. S. MIKHALAPOV, National Research Council

Vice-Chairman—C. W. DODGE, Sciaky Bros.

Impact Strength of Arc Welded Joints in Aircraft Steel
by H. O. KLINKE, Republic Aviation Corp.

Helium Shielded Arc Welding of Stainless Steel Exhaust Collectors
by FRANCIS H. STEVENSON, Lockheed Aircraft Corp.

Multi-Arc Welding of Aluminum Alloys
by M. R. RIVENBURGH and C. W. STEWARD, Curtiss-Wright Corp.

RESEARCH

Chairman—ISAAC HARTER, The Babcock & Wilcox Co.

Vice-Chairman—E. R. SEABLOOM, Crane Co.

Intergranular Corrosion of Stainless Steel Welds
by WM. T. TIFFIN, University of Oklahoma

The Effect of Time & Temperature on the Relief of Residual Stresses in Low Alloy Steels
by J. K. McDOWELL, and PAUL C. CUNNICK, Lt. Col. Ordnance Dept., Rock Island Arsenal

Development and Application of Modern Heavy Coated Arc Welding Electrodes
by D. C. SMITH and W. G. RINEHART, Harnischfeger Corp.

OPEN SESSION—WELDABILITY RESEARCH COMMITTEE

The Tee-Bend-Energy Test
by LEON C. BIBBER and JULIUS HEUSCHKEL, Carnegie-Illinois Steel Corporation

FACTS YOU SHOULD KNOW ABOUT STANDARD RUTILE AND FERRO MANGANESE

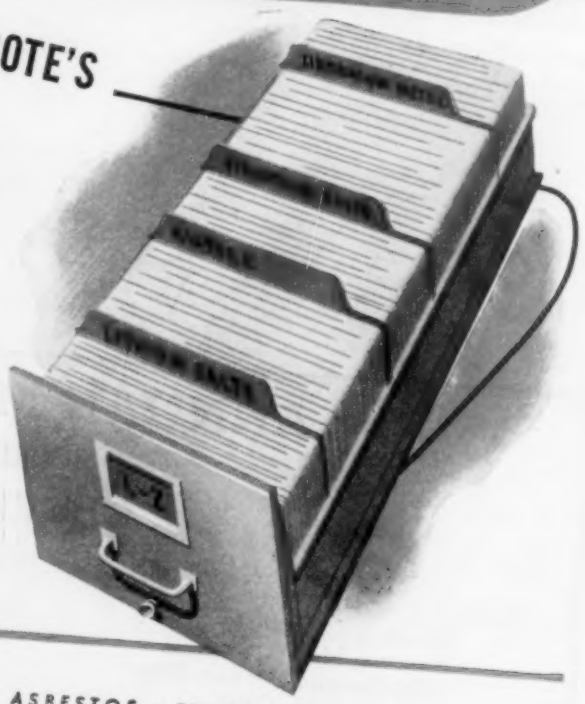
ALL THAT Standard Rutile now means to welding rod manufacturers and their customers is wrapped up in that word "standard."

Rutiles are shipped from several countries, normally from India, Australia and Brazil. Each rutile has certain operating characteristics which can be traced to impurities indigenous to its country of origin. Standard Rutile comes from Brazil. Tests have shown that, conditions being equal, Standard Rutile produces less spatter and a higher burning rate in all-position type coatings. Standard Rutile, processed by Foote, has other and important benefits. Particle size and variations of the product are rigidly controlled by our laboratory to insure minimum spatter loss, maximum arc stability and smooth operation. Particle size and laboratory control, in short—standardization—have as much to do with rod performance as chemical composition.

Ferro Manganese is another welding product vastly improved by Foote processing. Normally, Ferro Manganese reacts vigorously with sodium silicate, forming a troublesome gas. This condition is aggravated by an excessive percentage of fines. Fine material also burns faster in the arc, resulting in a waste of manganese. Foote exercises a careful control over the fines in both High Carbon and Medium Carbon grades of Ferro Manganese. Both grades are ground all through 50 mesh and a maximum of 1% held on 60 mesh, and held to a maximum of 35% through 325 mesh. Because of Foote control you get more usable Ferro Manganese for your money. If you're not yet using these two Foote products, write for samples and analyses.

THIS FILE MEANS BUSINESS—FOOTE'S

From "A" for "Air Conditioning" and "Ammunition" to "W" for Welding and "White ware", Foote research and products are in demand by American industries. Whatever your business there is a strong possibility that you can use one of the hundreds of Foote products (ores, minerals, chemicals and alloys) to advantage or that you may benefit through Foote research. Find out what Foote is doing within your industry. Let Foote work with you in developing the materials you use.



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MINERAL COMPANY
A Step Ahead in Industrial Ores and Chemicals

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Home Office: 1611 SUMMER STREET, PHILADELPHIA, PA.
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Wednesday Afternoon—2:00 P.M.

THREE SIMULTANEOUS SESSIONS

AIRCRAFT

Chairman—G. O. HOGLUND, Aluminum Co. of America

Vice-Chairman—E. S. JENKINS, Curtiss-Wright Research Lab.

The Geometry of a Spot Welding Tip and Its Relation to Tip Life
by E. D. CRAWFORD and C. W. STEWARD, Curtiss-Wright Corp.

Survey of Chemical Cleaning Practices for Spot Welding Aluminum Alloys
by F. M. MORRIS, Kaiser Cargo, Inc., Fleetwings Div.

An Evaluation of Process Control of Aircraft Welding
by P. H. MERRIMAN, The Glenn L. Martin Co.

Characteristics of Welding Arcs on Aluminum in Atmospheres of Helium and Argon
by F. A. WASSELL, General Electric Co.

MACHINERY

Chairman—A. E. GIBSON, Wellman Engineering Co.

Vice-Chairman—R. J. KRIZ, The James H. Herron Co.

Production Problems and Production Control
by E. C. BREKELBAUM, Harnischfeger Corp.

Routine Inspection and Salvage of Machinery Weldments — Rough, Partially Machined and Machined
by JAMES W. OWENS, Fairbanks, Morse & Co.

Welded Jigs and Fixtures
by A. N. KUGLER, Air Reduction Sales Co.

Design of Welded Machinery
by JOHN MIKULAK, Electric Machinery Manufacturing Co.

PIPING AND PRESSURE VESSELS

Chairman—A. C. WEIGEL, Combustion Engineering Co.

Vice-Chairman—R. W. EMERSON, Pittsburgh Piping & Equipment Co.

Pressure Vessel Welding
by EDWARD B. McGUIRE, Hamler Boiler & Tank Co.

Normalizing of Welds in Carbon-Molybdenum Steel Pipe by 60-Cycle Induction Heating
by I. A. ROHRIG and D. H. COREY, The Detroit Edison Co.

Properties of Welded Joints Between Dissimilar Metals
by E. C. CHAPMAN and R. E. LORENTZ, Combustion Engineering Co.

Oxy-Acetylene Pressure Welding
by A. R. LYTLE, Union Carbide & Carbon Res. Labs.

Wednesday Evening—6:30 P.M.

Section Officers Dinner and Conference

THURSDAY, OCTOBER 19th, Morning—9:30 A.M.

TWO SIMULTANEOUS SESSIONS

FOUNDRY

Chairman—L. A. DANSE, Cadillac Motor Car Div.

Vice-Chairman—AUSTEN J. SMITH The Lunkenheimer Co.

Arc Welding Practices in the Steel Foundry
by FRANK KIPER and LAWRENCE GABES, Ohio Steel Foundry

Machine Cutting of Risers, Flame Scarfing to Remove Padding, and Flame Gouging to Remove Webs and Defects
by G. E. BELLEW, Air Reduction Sales Co.

Repair of Castings
by L. A. DANSE, Chairman, GM Metallurgical Comm., General Motors Corp.

MISCELLANEOUS

Chairman—W. E. CRAWFORD, A. O. Smith Corp.

Vice-Chairman—A. L. PFEIL, Universal Power Corp.

Low Temperature Joining
by W. D. WASSERMAN, and C. E. SWIFT, Eutectic Welding Alloys Co.

How Much Ductility Is Necessary for a Structure or Machine?
by W. J. CONLEY, Lincoln Electric Co.

Thursday Afternoon—2:00 P.M.

Business Meeting

3:00 P.M.

Board of Directors Meeting

ANNUAL MEETING, A. W. S.

HOTEL CLEVELAND

CLEVELAND, OHIO

Make Reservations Early

Write to
Housing Committee
National Metal Congress
1604 Terminal Tower Bldg.
Cleveland 13, Ohio

Mention American Welding Society